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Adaptivity in CEA's Fluid Elements in EUROPLEXUS

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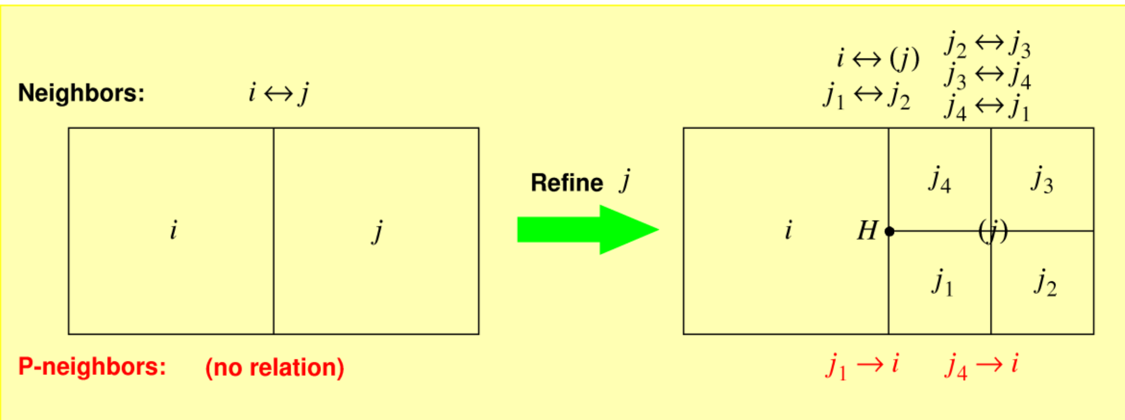

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1. Introduction

This report is a sequel to reports and publications [1-13] on mesh adaptivity in fast transient dynamics and presents the implementation of mesh adaptivity for CEA's fluid elements (triangles and quadrilaterals in 2D, tetrahedra and hexahedra in 3D) in fast transient dynamics. The algorithms are implemented in the EUROPLEXUS code.

EUROPLEXUS [14] is a computer code for fast explicit transient dynamic analysis of fluid-structure systems jointly developed by the French Commissariat à l'Energie Atomique et aux Energies Alternatives (CEA Saclay) and by the Joint Research Centre of the European Commission (JRC Ispra).

Reference [1] presented the first implementation in EUROPLEXUS of an adaptive mesh refinement and un-refinement procedure, in two space dimensions (element shape QUA4) for solid mechanics. The procedure was extended to fluid mechanics (FE formulation) in 2D in reference [2]. Then, reference [3] applied a similar refinement and un-refinement procedure in three space dimensions to the CUB8 element shape, both in solids mechanics and in fluid mechanics (FE formulation).

All numerical examples presented in references [1-3] with a variable mesh used a so-called "manual" mesh adaptation directive, the `WAVE` directive (see the code manual in reference [14]), first introduced in reference [1]. This directive refines the mesh along "wavefronts" that are specified by the user, e.g. according to a known analytical solution to the problem considered. This technique was used with success to simulate a bar problem (in solid mechanics) and a shock tube problem (in fluid mechanics) both in 2D and in 3D [1-3].

However, those solutions cannot be qualified as "true" adaptive solutions, because in (true) adaptivity mesh refinement and un-refinement should be completely automatic, based upon suitable *error estimators* or *error indicators*. The formulation of error estimators in fast transient dynamics is challenging and is still a subject of research. The use of so-called error indicators, however, is much simpler. For this reason, subsequent work in EUROPLEXUS focused on error indicators. References [4] and [5] document a first prototype implementation of adaptivity based upon error indicators in EUROPLEXUS, limited to 2D problems in continuum and fluid mechanics. An extension of the indicator technique to 3D is under development but has not been completed and documented yet.

Publications [6-7] focus on the natural quantities of interest in goal-oriented error assessment and adaptivity, but limited to the case of linear elasto-dynamics.

The adaptive technique was then applied to Cell-Centred Finite Volumes (CCFV) for the description of the fluid domain, first in 2D (see [8]) and then also in 3D [9]. More recently, the technique has also been extended for use with the CDEM combustion model which makes use of the CCFV formulation [10]. A complete description of the element refinement and un-refinement techniques used in mesh adaptation has been published in a paper [11]. Finally, reference [12] shows the combination of mesh adaptivity with Fluid-Structure Interaction, i.e. the automatic fluid mesh refinement and un-refinement near a moving and deforming structure.

Reference [13] extends mesh adaptivity to simplex element shapes, i.e. the 3-node triangle (TRI3) in 2D and the 4-node tetrahedron (TET4) in 3D. These elements are useful in fully general unstructured meshing of complex geometries. The extension covered solid continuum elements (CEA's TRIA and TETR elements *with solid material*), and for fluid Finite Elements (JRC's FL23 and FL34 elements) and Cell-Centered Finite Volumes (CEA's T3VF and TEVF elements).

The present work completes the implementation by extending adaptivity to CEA's fluid finite elements both in 2D (TRIA and CAR1) and in 3D (TETR and CUBE). The CAR1 is treated like other 2D quadrilaterals (Q41L, FL24) as far as geometrical issues are concerned. In addition to the solid case, the activation of adaptivity for fluids requires the suitable treatment of transport terms which arise in the Eulerian or ALE forms of the governing equations. For the CEA's fluid finite elements mentioned above (TRIA, CAR1, TETR and CUBE) this is done in routines `tr2me.ff` (for the 2D case) and `tr3me.ff` (for the 3D case), respectively. Therefore, most modifications for the current implementation are concentrated in those two routines. Actually, a special version of the routines is written, valid for the mesh adaptive case, but incompatible (for the moment) with the KAAPI library and with spatial partitioning, in order to limit the complexity of the resulting code.

This document is organized as follows:

- Section 2 presents the treatment of transport terms.
- Section 3 presents some numerical examples with 2D fluid elements (TRIA, CAR1).
- Section 4 presents some numerical examples with 3D fluid elements (TETR, CUBE).
- The references are listed in Section 5.

The Appendix contains a listing of all the input files mentioned in the present report.

2. Treatment of transport terms in adaptivity for CEA's fluid FEs

The CEA implementation of fluid Finite Elements differs somewhat from the one of JRC similar elements, that had been described e.g. in Section 2.2 of reference [2]. The conservation equations (Euler equations) are the same in both cases, of course, but CEA's approach is to use the same element routine for both solid and fluid, and to treat the transport terms in a separate routine (tr2me.ff for the 2D case and tr3me,ff for the 3D case). These routines compute the mass and energy transport terms across each face of the fluid elements. Faces are 2-node segments in 2D, and either 3-node triangles or 4-node quadrilaterals in 3D.

Although there are differences with respect to JRC's implementation, the key point is that in both cases the so-called "lowest-index rule" is used when computing transport between two neighboring elements, see Section 2.2.3 of reference [2]. Therefore, in CEA's fluid elements a similar extension to the adaptive case can be applied to the one adopted in JRC case and described in detail in Section 2.3 of reference [2].

This extension is based upon the generalization of "neighbor" definition and on the addition of a "pseudo-neighbor" definition, which applies to portions of the fluid-fluid interfaces which are non-conforming due to the presence of so-called hanging nodes in an adaptively refined mesh. These definitions are recalled below, see also the Figure 1 from reference [2].

Definition of (regular) neighbor element in adaptivity

The neighbor of an element across a given face is the same-level, active or inactive element on the other side of the face, or 0 if there is no such element.

Definition of pseudo-neighbor element in adaptivity

The pseudo-neighbor of an (active) element across a given face is the larger (i.e. lower-level) active element on the other side of the face, or 0 if there is no such element. Inactive elements have no pseudo-neighbors.

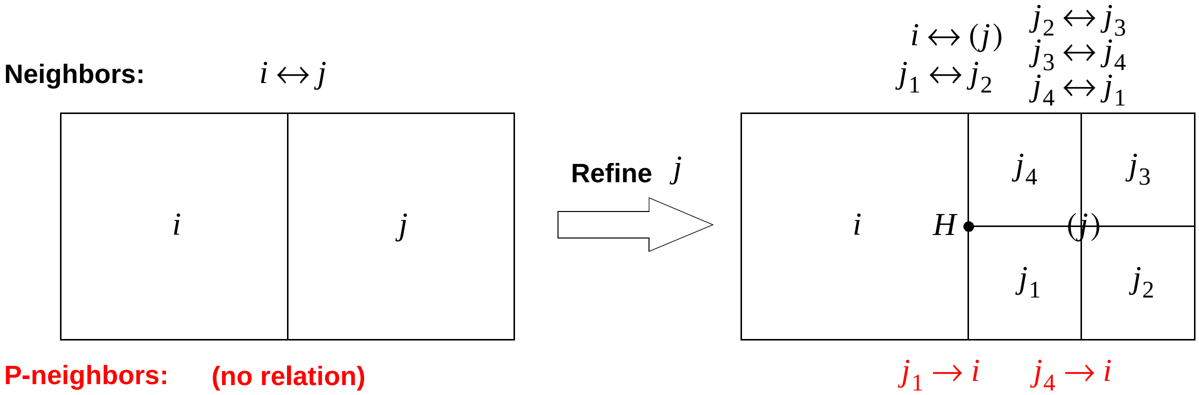

Figure 1 - Neighboring (in black) and pseudo-neighboring (in red) relations

The generalized transport algorithm, valid both in the normal (non-adaptive) and in the adaptive case, can therefore be reused as such from Section 2.3.5 of reference [2], also in the case of CEA's fluid elements. The algorithm is reported below for completeness.

General (non-adaptive or adaptive) transport algorithm

1. Set total transport of mass and energy to zero for all elements.
2. Loop over the elements.
   3. Loop over the faces of the current element i.
      4. Let j be the neighbor of i across the current face.
      5. If there is no adaptivity in the calculation, then (standard procedure):
         6. If $j = 0$ (i.e., if there is no neighbor) skip transport for this face (GO TO 21).
         7. Else, if $j < i$ skip transport for this face (GO TO 21).
         8. Else $j > i$: compute the transports of mass ΔM and of internal energy ΔI between i and j, add them (with the correct sign) to the total transport of mass and energy of element j, and subtract them from the total transport of mass and energy of element i. Go to next face (GO TO 21).
      9. Else there is adaptivity in the calculation.
         10. If $j = 0$ (i.e. if there is no neighbor), let k be the pseudo-neighbor.
            11. If $k = 0$ (i.e., if there is no pseudo-neighbor) or $k < i$, skip transport for this face (GO TO 21).
            12. Else $k > i$: compute the transports of mass ΔM and of internal energy ΔI between i and k, add them (with the correct sign) to the total transport of mass and energy of element k, and subtract them from the total transport of mass and energy of element i. Go to next face (GO TO 21).
         13. Else, $j > 0$ (j is the neighbor of i across the current face).
            14. If element j is active then:
               15. If $j < i$, skip transport for this face (GO TO 21).
               16. Else $j > i$: compute the transports of mass ΔM and of internal energy ΔI between i and j, add them (with the correct sign) to the total transport of mass and energy of element j, and subtract them from the total transport of mass and energy of element i. Go to next face (GO TO 21).
            17. Else, j is inactive. Search and loop over all active descendents k of j which see i as pseudo-neighbor.
               18. If $k < i$, skip transport for this k (GO TO 20).
               19. Else $k > i$: compute the transports of mass ΔM and of internal energy ΔI between i and k by using the geometry of k, not of i, add them (with the correct sign) to the total transport of mass and energy of element k, and subtract them from the total transport of mass and energy of element i. Go to next k (GO TO 20).
            20. Next k (GO TO 15).
   21. Next face (GO TO 3).
   22. All faces have been considered for the current element and therefore its total transport of mass and energy has been computed. Update the element state to its final (end-of-step) value and compute internal forces.
23. Next element (GO TO 2)

As anticipated in the Introduction, the (adaptive part of the) above algorithm is implemented in two new routines, `tr2me_adap.ff` for the 2D case and `tr3me_adap.ff` for the 3D case, respectively. These routines are called from the element routines whenever adaptivity is activated in a calculation, in place of the "normal" routines `tr2me.ff` and `tr3me.ff`. The separation of cases is useful to keep the algorithms readable. However, a drawback of this implementation is that adaptivity cannot be combined with the KAAPI library, nor with spatial partitioning (such cases are only treated in the normal non-adaptive version of the routines).

3. Numerical examples in 2D

We present some numerical examples in order to test the algorithms described in the previous Sections.

3.1 Shock tube in 2D

The first example is a classical shock tube, similar to those considered in reference [2]. The adaptive mesh refinement is piloted by the `WAVE` directive.

First, reference solutions are obtained by means of a fine mesh of (non-adaptive) triangles (TRIA) or quadrilaterals (CAR1). Then, adaptive solutions with triangles or quadrilaterals are obtained. All performed calculations are summarized in Table 1.

Case	Base Mesh	Notes	Steps	CPU [s]	Els*step
FETR00	1,600 TRIA	Non-adaptive fine mesh CSTA 0.5	1,082	2.5	1,732,800
FETR01	200 TRIA	WAVE 4 PLAN MAXL 4 CSTA 0.25	2,279	7.9	2,865,237
FEQU00	800 CAR1	Non-adaptive fine mesh CSTA 0.5	838	1.6	671,200
FEQU01	100 CAR1	WAVE 4 PLAN MAXL 4 CSTA 0.25	1,681	4.9	1,056,875

Table 1 - Calculations for the shock tube problem with 2D Finite Elements

FETR00

This test uses a fine non-adaptive fluid mesh, of $800 \times 2 = 1600$ triangular fluid elements TRIA. To obtain a solution with relatively few oscillations near the shock front, it is necessary to add some damping: `OPTI AMOR QUAD 4.0 LINE 0.2`. The solution is shown in Figures 2 (pressure), 3 (density) and 4 (velocity). This is taken as a reference for the subsequent adaptive solution.

FETR01

This solution is adaptive and uses a coarse base fluid mesh of 200 triangles, and four `WAVE` directives to track the wavefronts, with a maximum refinement level `MAXL 4`. A stability coefficient of 0.25 (instead of 0.5 like in the reference case) is needed to ensure stability. The solution is shown in Figures 5 (pressure), 6 (density) and 7 (velocity) and is in reasonable agreement with the reference.

FEQU00

This test uses a non-adaptive fine fluid mesh, of 800 quadrilateral fluid elements CAR1. To obtain a solution with relatively few oscillations near the shock front, it is necessary to add some damping:

OPTI AMOR QUAD 4.0 LINE 0.2. The solution is shown in Figures 8 (pressure), 9 (density) and 10 (velocity). This is taken as a reference for the subsequent adaptive solution.

FEQU01

This solution is adaptive and uses a coarse base fluid mesh of 100 CAR1, and four WAVE directives to track the wavefronts, with a maximum refinement level MAXL 4. A stability coefficient of 0.25 (instead of 0.5 like in the reference case) is needed to ensure stability. The solution is shown in Figures 11 (pressure), 12 (density) and 13 (velocity) and is in reasonable agreement with the reference.

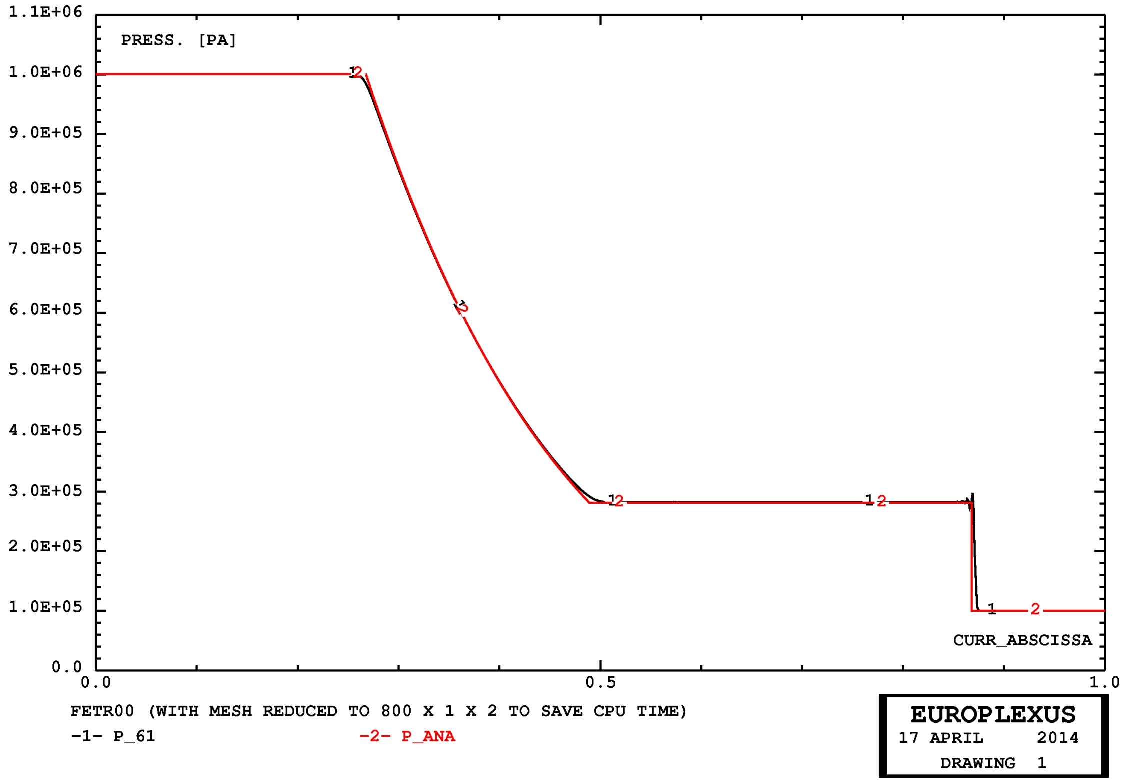

Figure 2 - Pressure in case FETR00

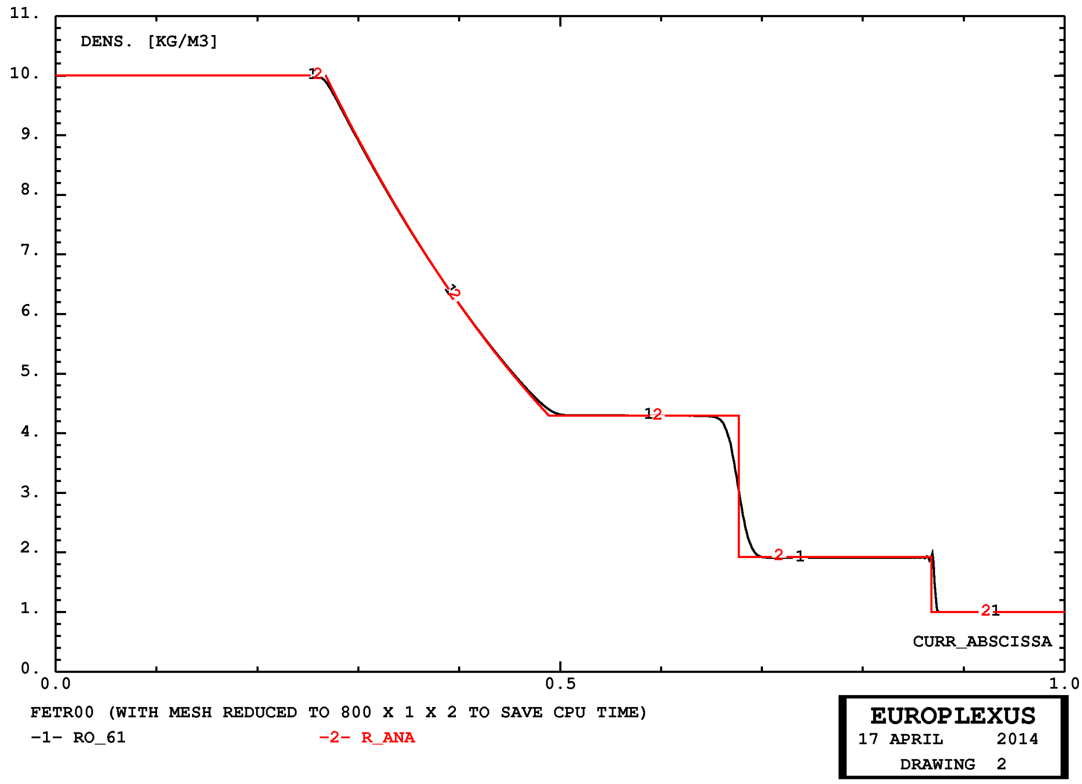

Figure 3 - Density in case FETR00

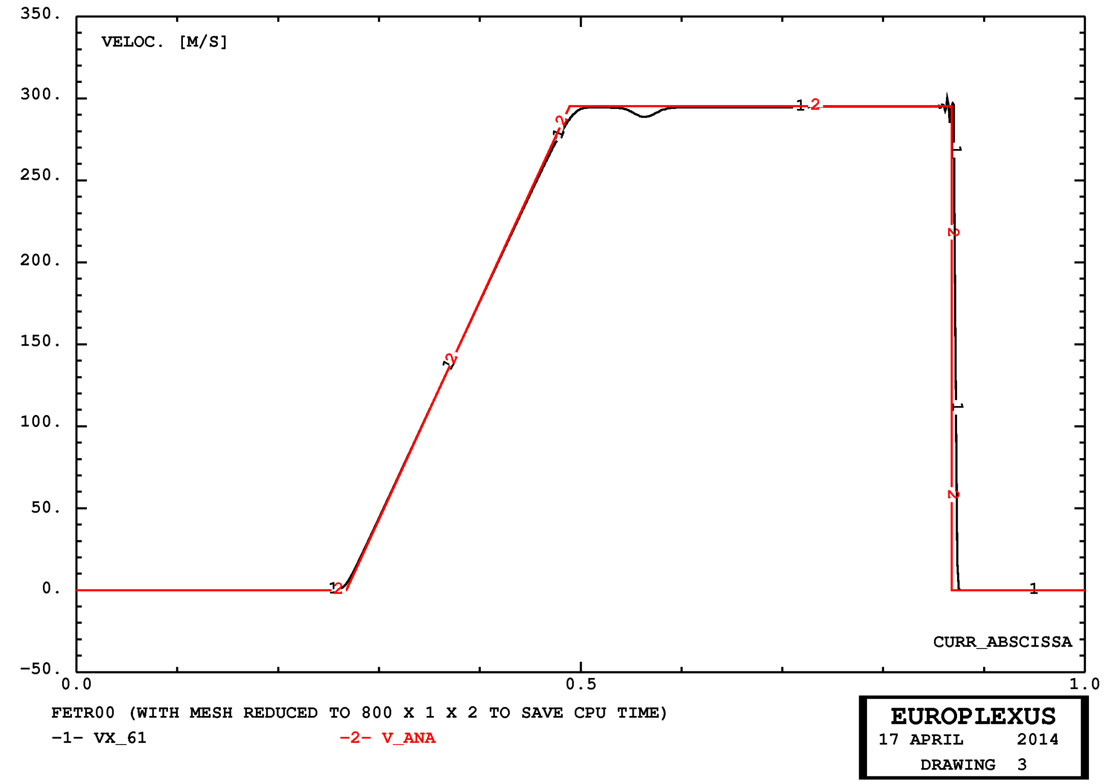

Figure 4 - Velocity in case FETR00

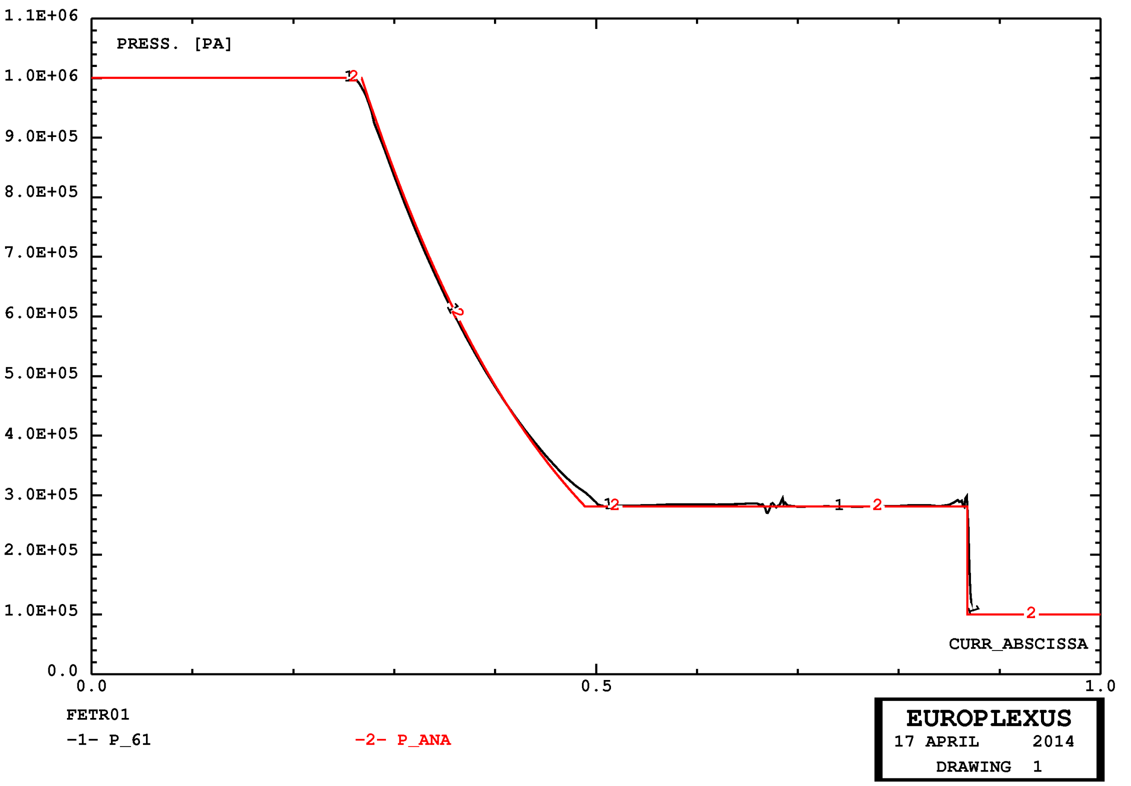

Figure 5 - Pressure in case FETR01

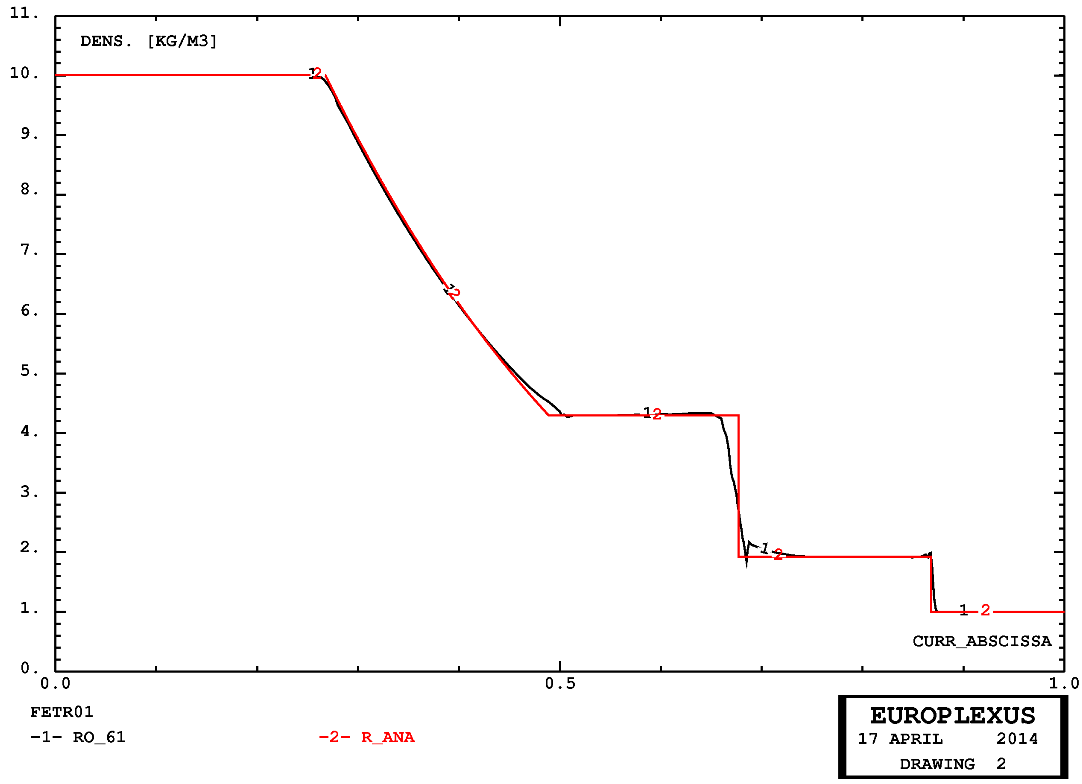

Figure 6 - Density in case FETR01

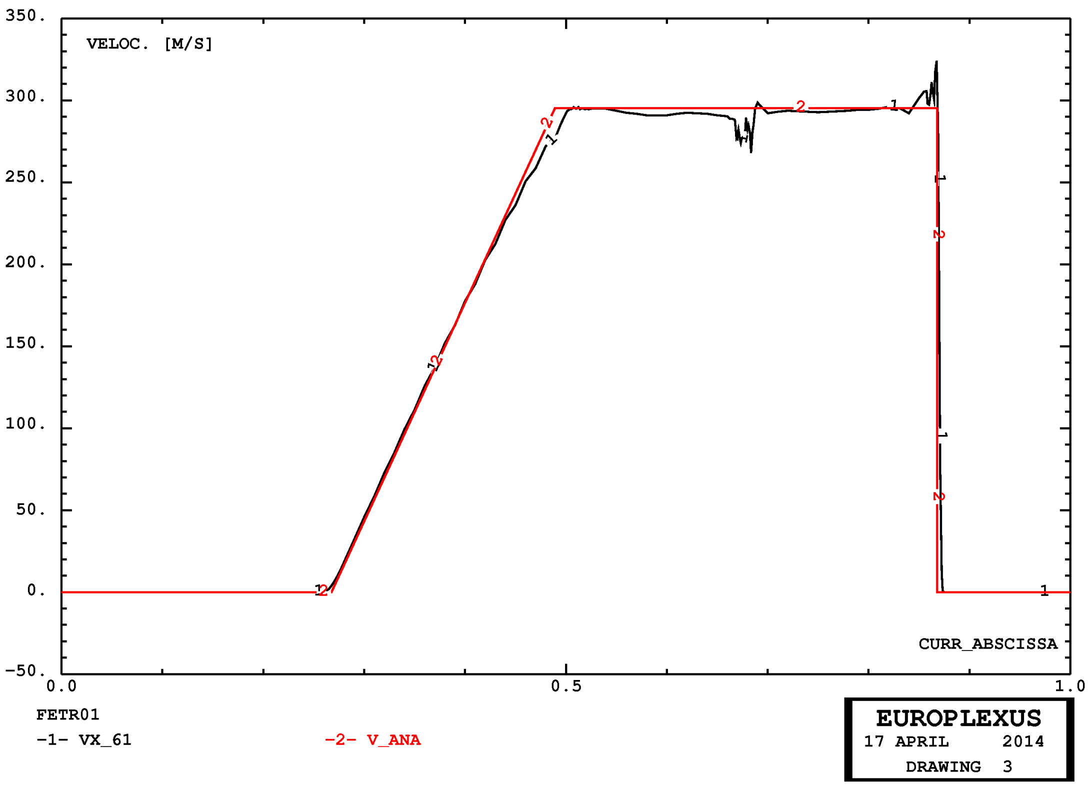

Figure 7 - Velocity in case FETR01

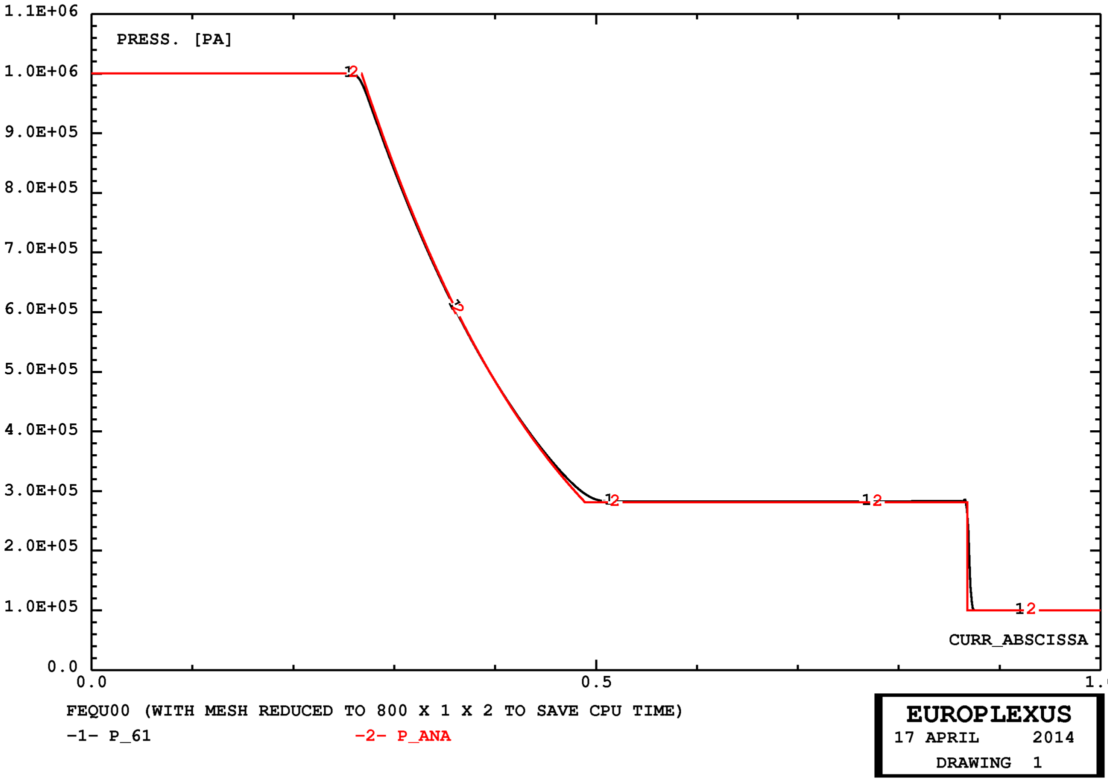

Figure 8 - Pressure in case FEQU00

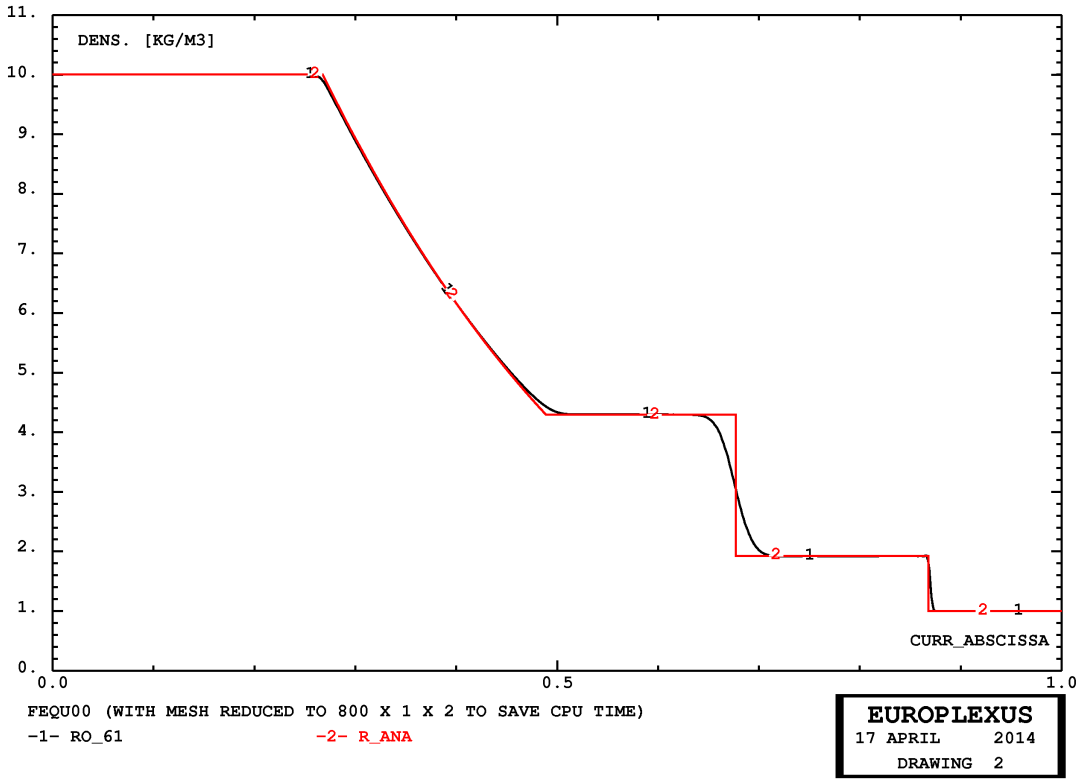

Figure 9 - Density in case FEQU00

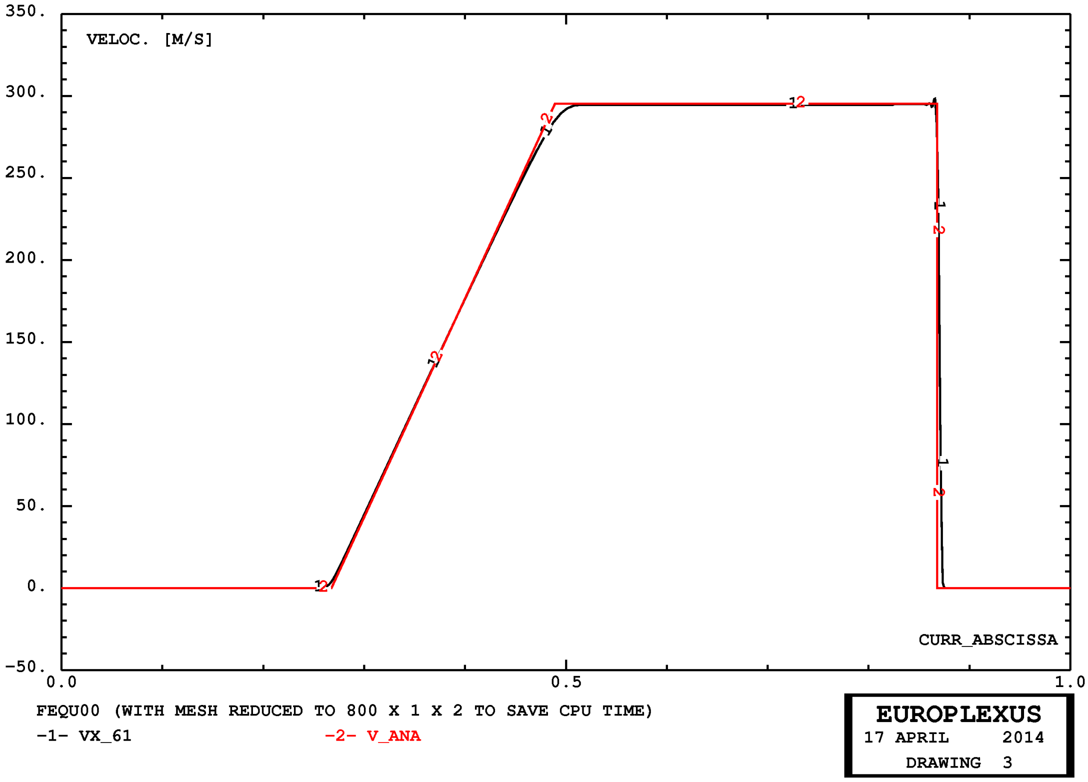

Figure 10 - Velocity in case FEQU00

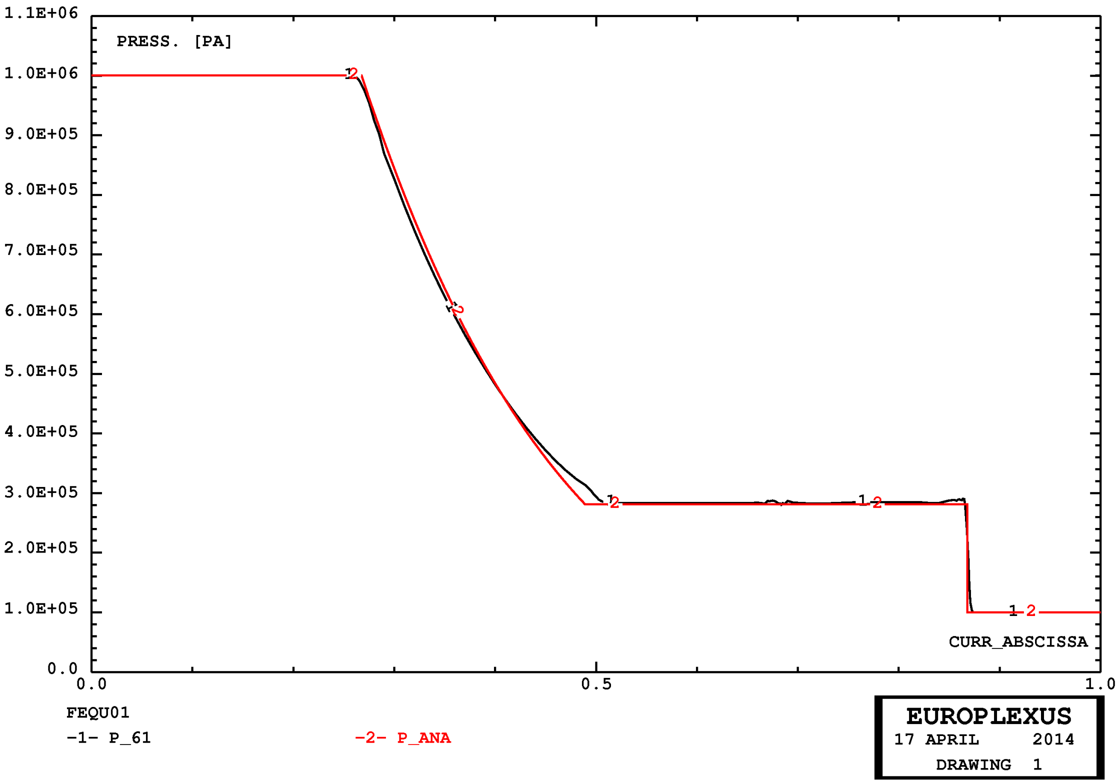

Figure 11 - Pressure in case FEQU01

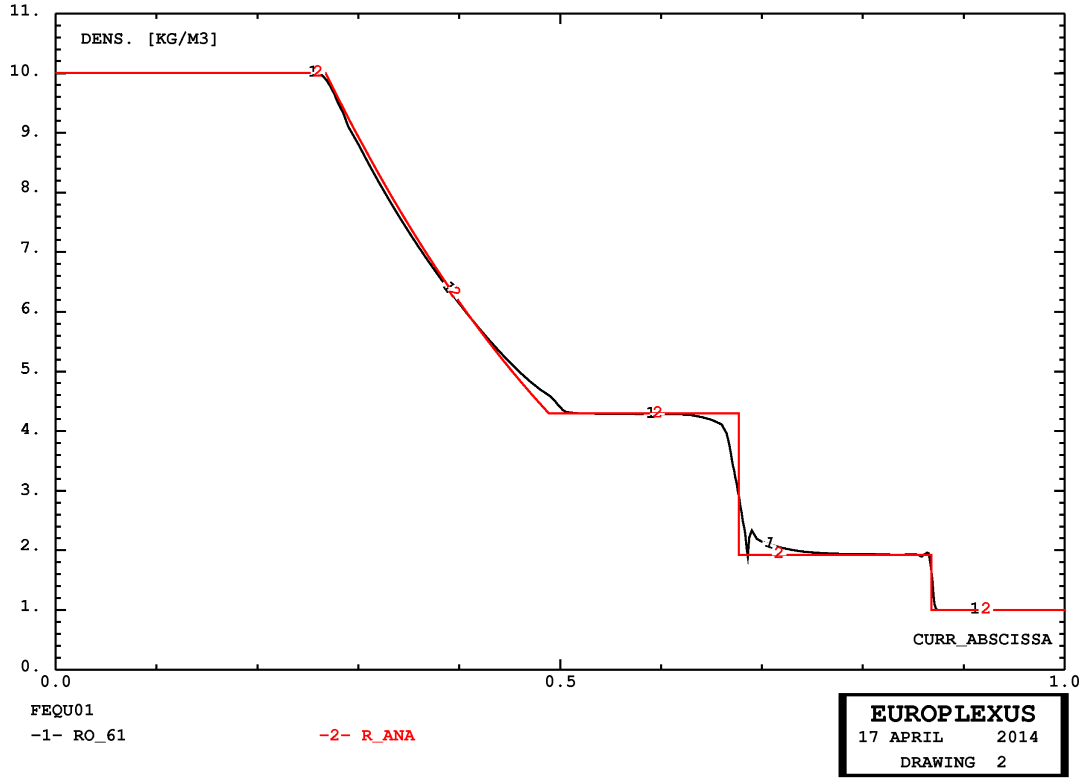

Figure 12 - Density in case FEQU01

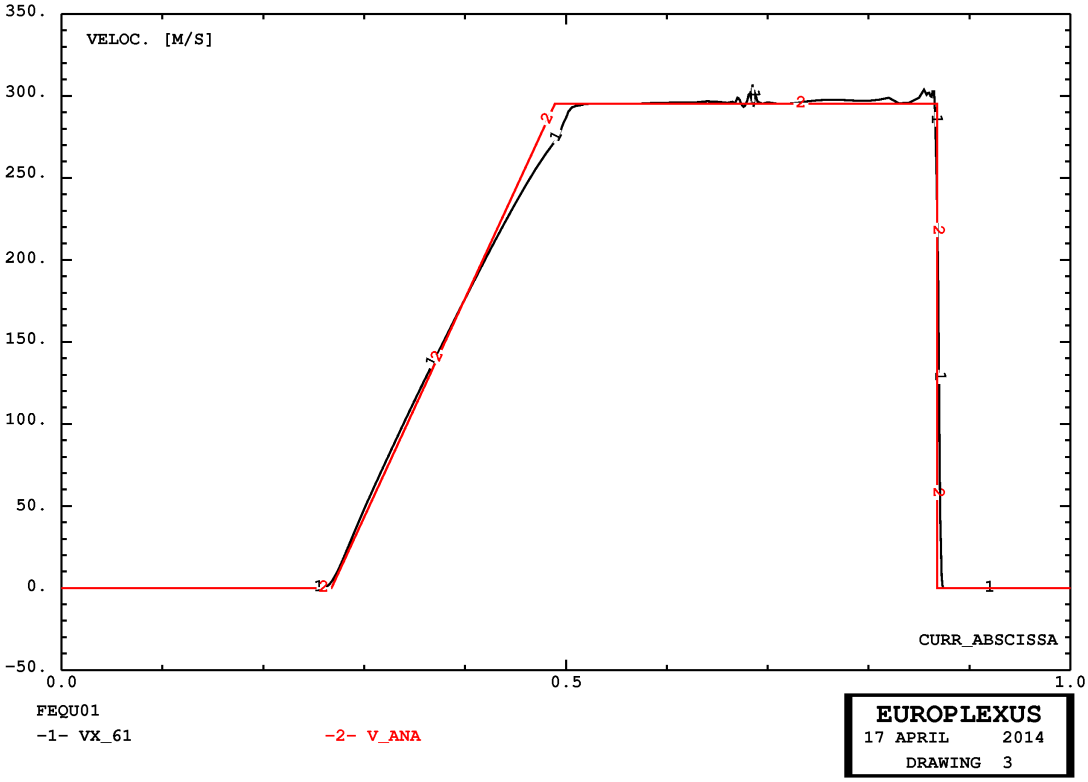

Figure 13 - Velocity in case FEQU01

4. Numerical examples in 3D

We present some numerical examples in order to test the algorithms described in the previous Sections.

4.1 Shock tube in 3D

The next example is a classical shock tube, similar to those considered in reference [2]. The adaptive mesh refinement is piloted by the `WAVE` directive.

First, reference solutions are obtained by means of a fine mesh of (non-adaptive) tetrahedra (TETR) or hexahedra (CUBE). Then, adaptive solutions with tetrahedra or hexahedra are obtained. All performed calculations are summarized in Table 2.

Case	Base Mesh	Notes	Steps	CPU [s]	Els*step
FET400	1,200 TETR	Non-adaptive fine mesh CSTA 0.5	237	0.7	285,600
FET401	1,200 TETR	WAVE 4 PLAN MAXL 3 CSTA 0.125	3,100	70.2	23,592,114
FEC800	100 CUBE	Non-adaptive fine mesh CSTA 0.5	119	0.2	12,000
FEC801	100 CUBE	WAVE 4 PLAN MAXL 3 CSTA 0.25	834	7.5	530,681

Table 2 - Calculations for the shock tube problem with 2D Finite Elements

FET400

This test uses a fine non-adaptive fluid mesh, of $100 \times 12 = 1200$ tetrahedral fluid elements TETR. To obtain a solution with relatively few oscillations near the shock front, it is necessary to add some damping: `OPTI AMOR QUAD 4.0 LINE 0.2`. The solution is shown in Figures 14 (pressure), 15 (density) and 16 (velocity). This is taken as a reference for the subsequent adaptive solution.

FET401

This solution is adaptive and uses the same base fluid mesh as the previous case, and four `WAVE` directives to track the wavefronts, with a maximum refinement level `MAXL 3`. A stability coefficient of 0.125 (instead of 0.5 like in the reference case) is needed to ensure stability. The solution is shown in Figures 17 (pressure), 18 (density) and 19 (velocity) and is in reasonable agreement with the reference.

FEC800

This test uses a non-adaptive fluid mesh, of 100 hexahedral fluid elements CUBE. To obtain a solution with relatively few oscillations near the shock front, it is necessary to add some damping: `OPTI AMOR QUAD 4.0 LINE 0.2`. The solution is shown in Figures 20 (pressure), 21 (density) and 22 (velocity). This is taken as a reference for the subsequent adaptive solution.

FEC801

This solution is adaptive and uses the same base fluid mesh as the previous case, and four `WAVE` directives to track the wavefronts, with a maximum refinement level `MAXL 3`. A stability coefficient of 0.25 (instead of 0.5 like in the reference case) is needed to ensure stability. The solution is shown in Figures 23 (pressure), 24 (density) and 25 (velocity) and is in reasonable agreement with the reference.

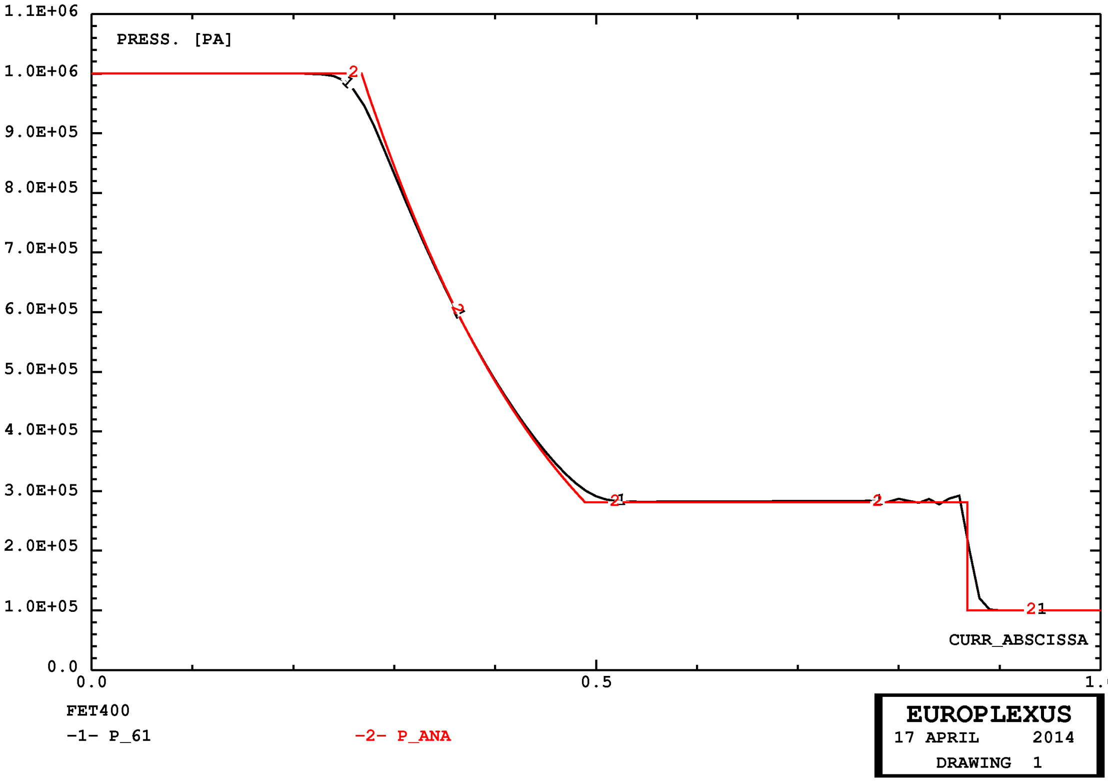

Figure 14 - Pressure in case FET400

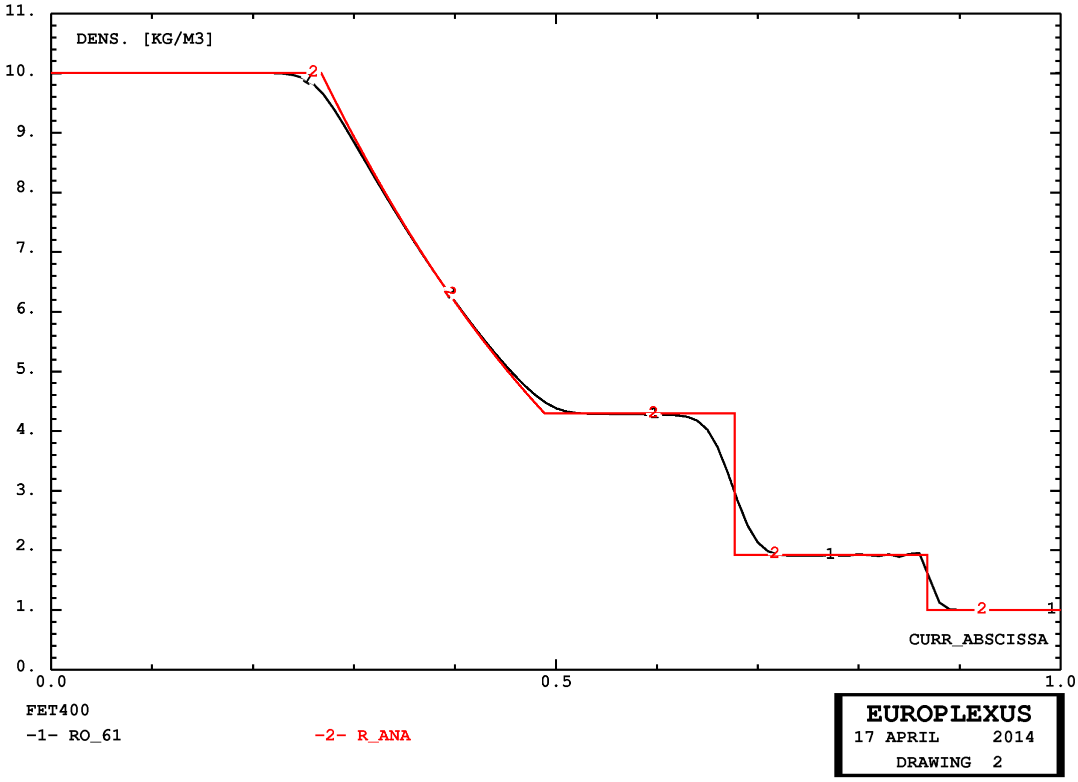

Figure 15 - Density in case FET400

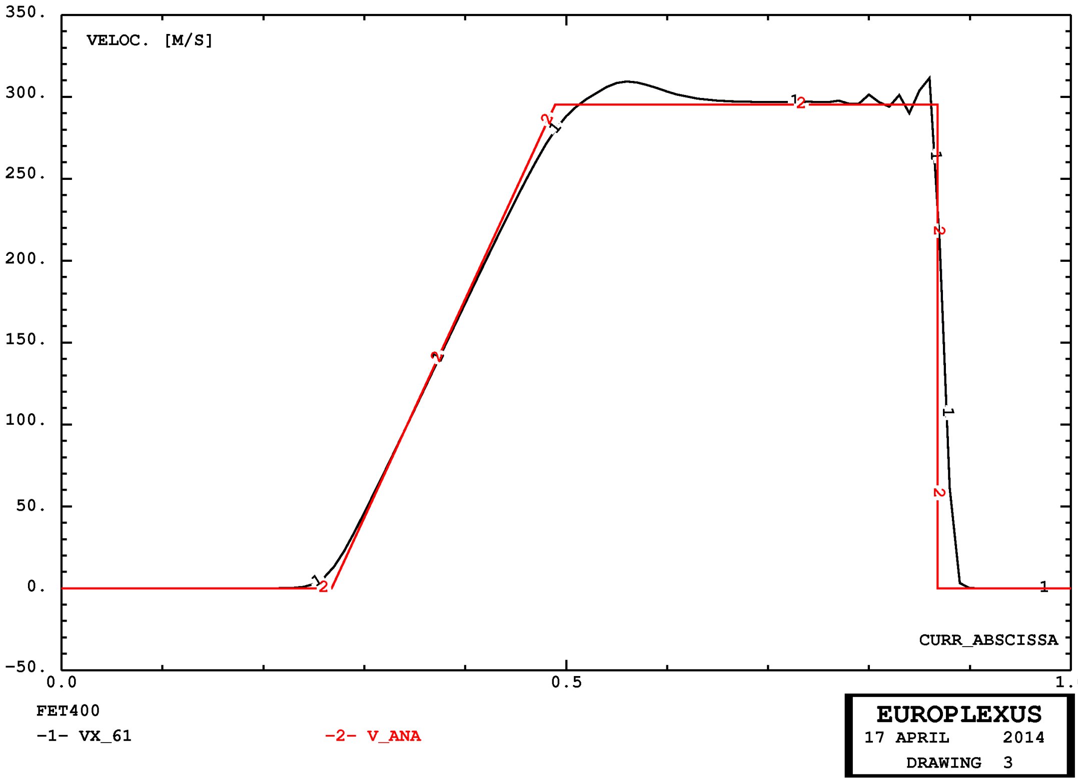

Figure 16 - Velocity in case FET400

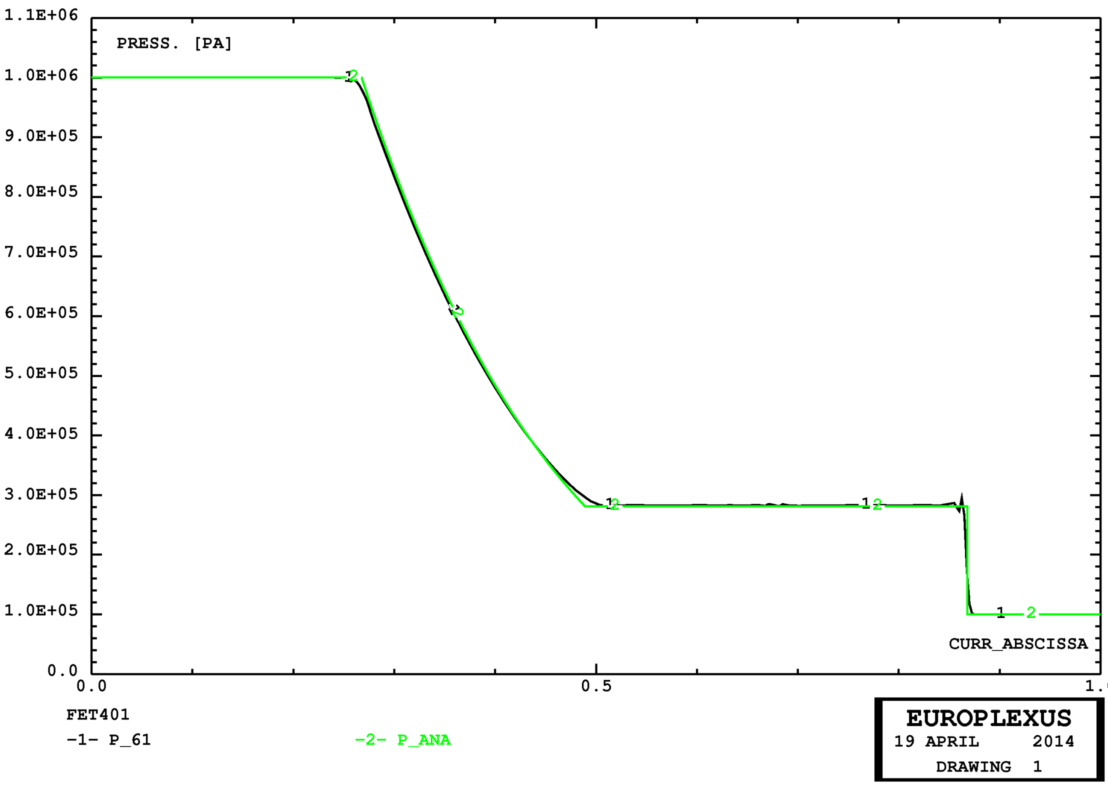

Figure 17 - Pressure in case FET401

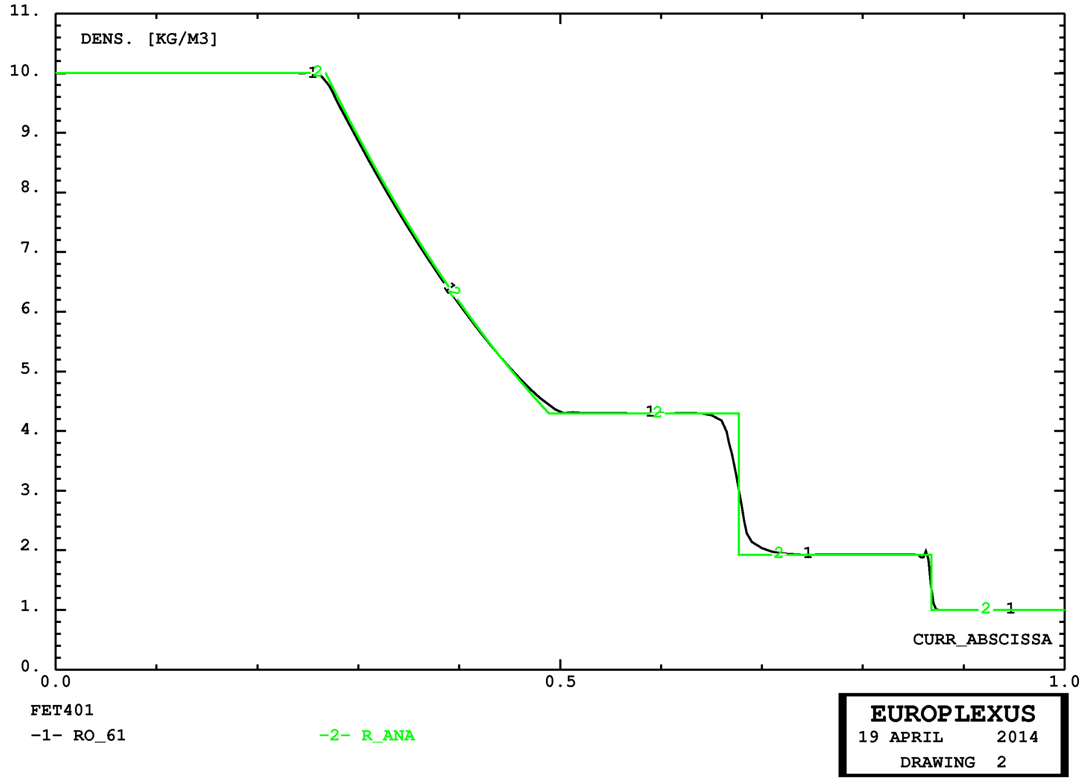

Figure 18 - Density in case FET401

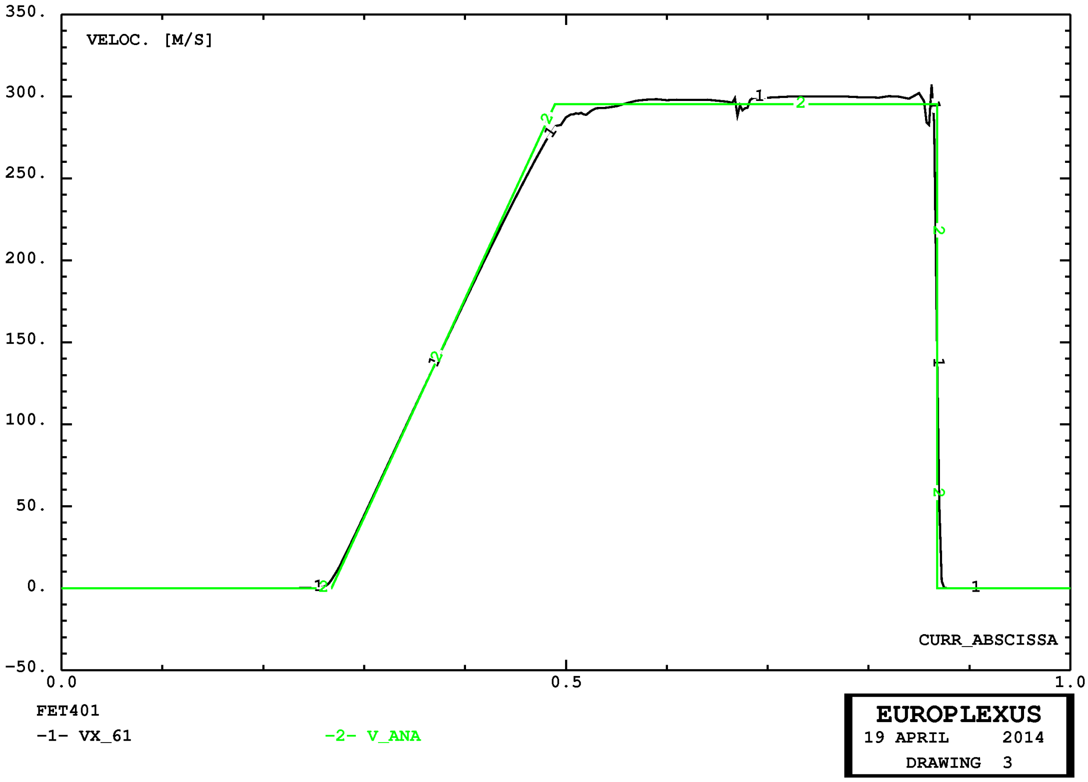

Figure 19 - Velocity in case FET401

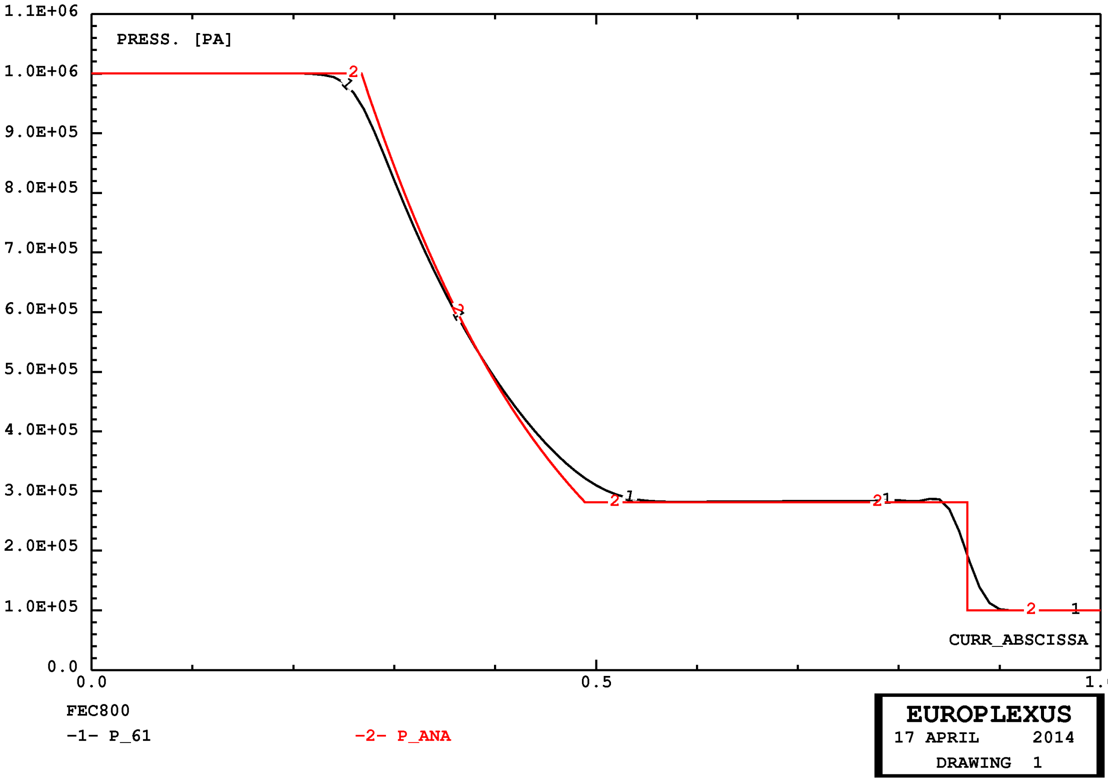

Figure 20 - Pressure in case FEC800

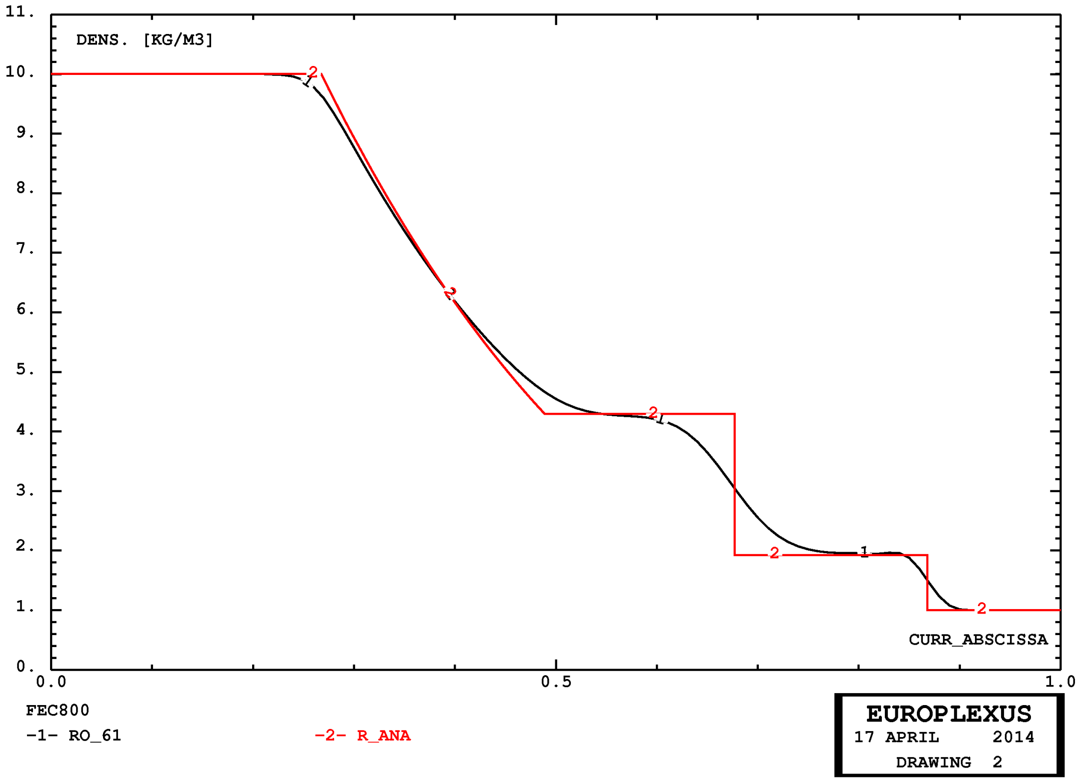

Figure 21 - Density in case FEC800

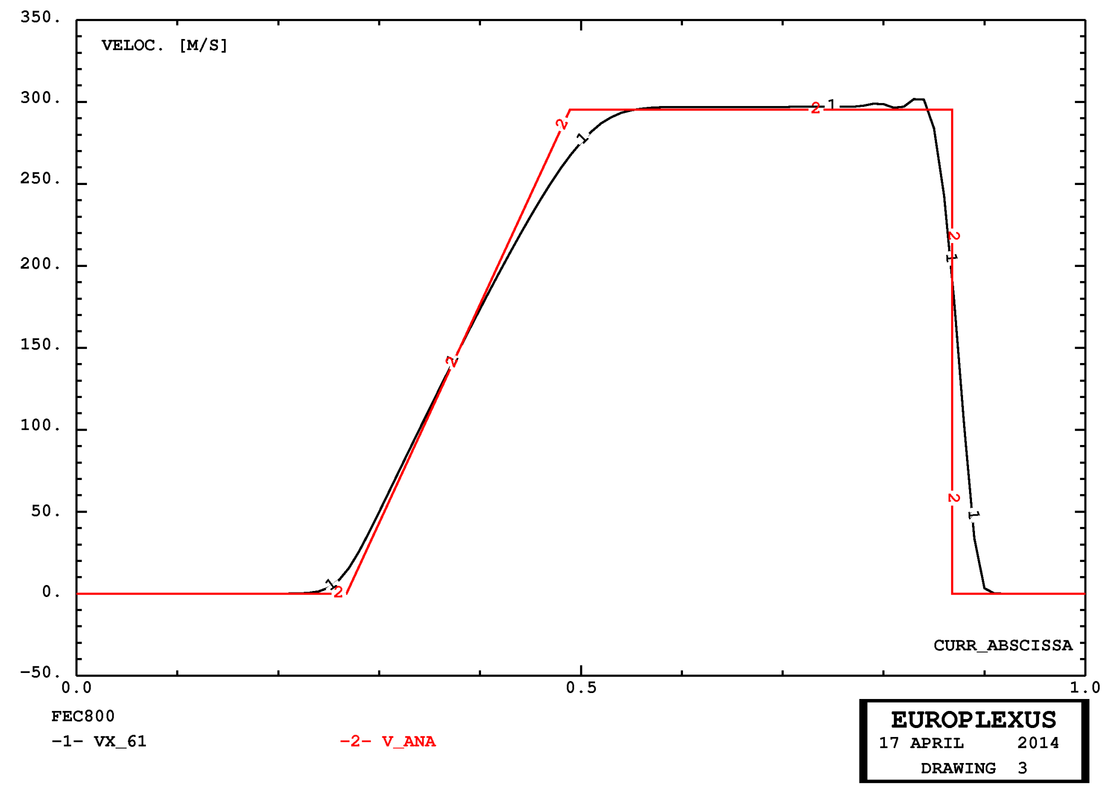

Figure 22 - Velocity in case FEC800

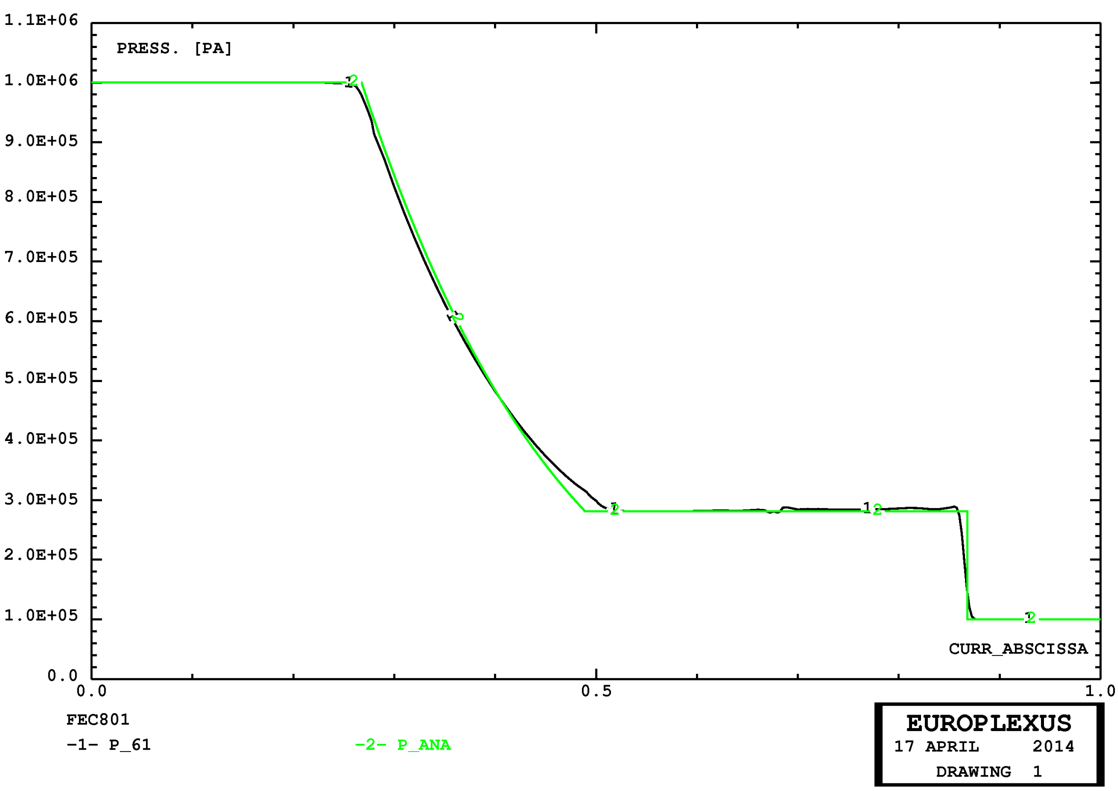

Figure 23 - Pressure in case FEC801

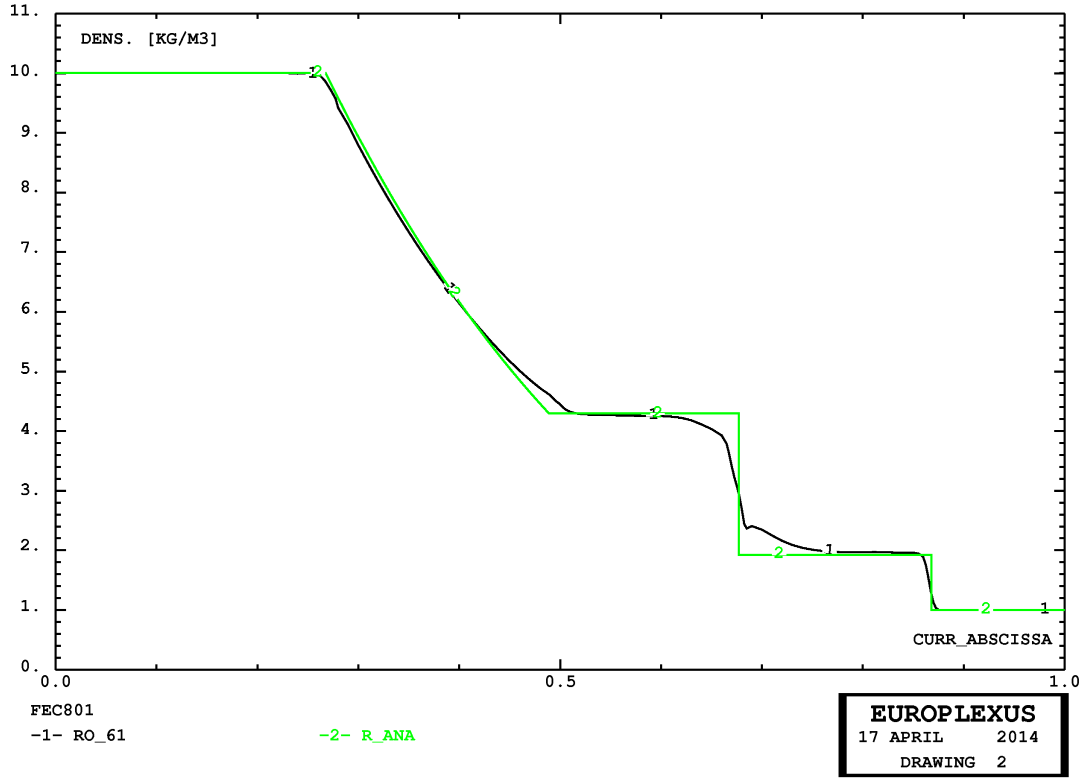

Figure 24 - Density in case FEC801

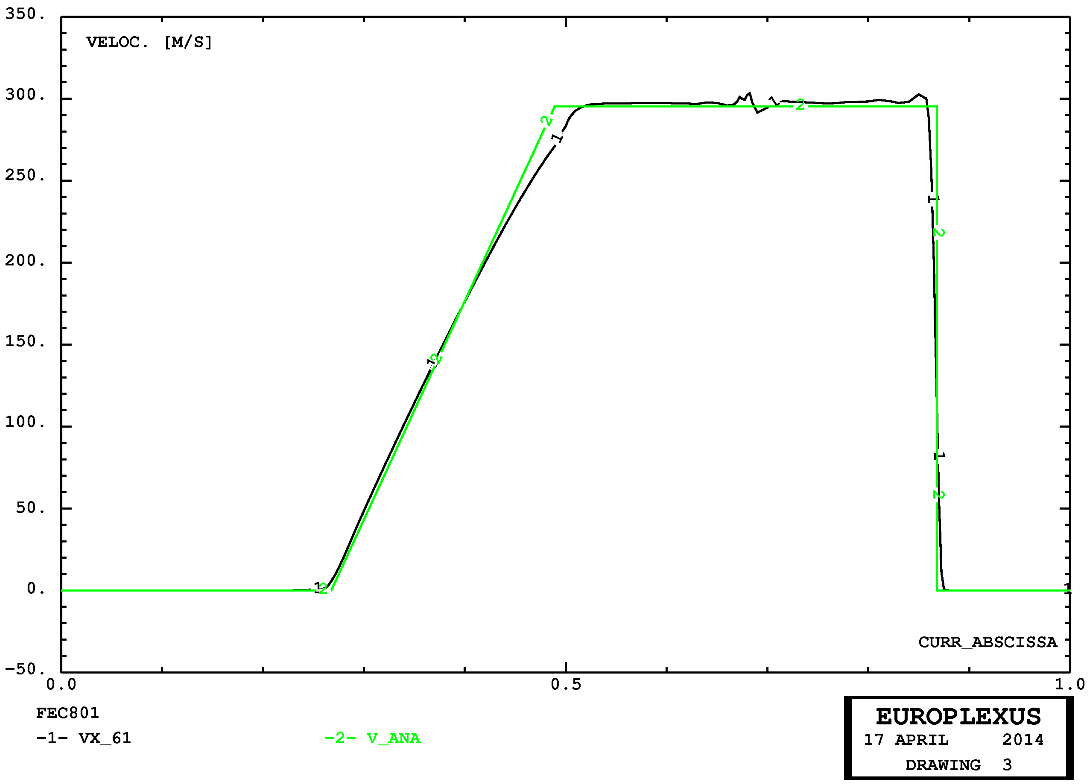

Figure 25 - Velocity in case FEC801

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[14] "*EUROPLEXUS User's Manual*", on-line version: http://europlexus.jrc.ec.europa.eu.

Appendix

Sample input files

This Section contains, in alphabetical file order, the listings of all input files related to the examples which were proposed in the previous Sections.

fec800.dgibi

```
opti echo 1;
opti dime 3 elem cub8;
opti titr 'FEC800';
opti sauv form 'fec800.msh';
opti trac psc ftra 'fec800_mesh.ps';
p0 = 0 0 0;
dd = 0.01;
n = 100;
p1 = 0 dd 0;
p2 = 0 dd dd;
p3 =  0 0 dd;
c1 = p0 d 1 p1;
c2 = p1 d 1 p2;
c3 = p2 d 1 p3;
c4 = p3 d 1 p0;
base = dall c1 c2 c3 c4 plan;
bar = base volu n tran ((n*dd) 0 0);
mesh = bar;
tass mesh;
sauv form mesh;
trac qual cach mesh;
fin;
```

fec800.epx

```
FEC800
ECHO
!CONV win
CAST mesh
EULE TRID
GEOM CUBE bar TERM
COMP GROU 4 'bar1' LECT 1 PAS 1 50 TERM
            'bar2' LECT 51 PAS 1 100 TERM
            'ea' LECT 26 TERM
            'eb' LECT 75 TERM
     NGRO 5 'xaxo' LECT bar TERM COND LINE X1 0 Y1 0 Z1 0
                                          X2 1 Y2 0 Z2 0 TOL 1.E-4
            'bas1' LECT bar TERM COND X LT 0.0001
            'bas2' LECT bar TERM COND X GT 0.9999
            'na'   LECT bar TERM COND NEAR POIN 0.25 0 0
            'nb'   LECT bar TERM COND NEAR POIN 0.75 0 0
     COUL ROUG LECT bar1 TERM
          VERT LECT bar2 TERM
MATE GAZP RO 10 GAMM 1.5 PINI 1.E6 PREF 1.E5
          LECT bar1 TERM
     GAZP RO  1 GAMM 1.5 PINI 1.E5 PREF 1.E5
          LECT bar2 TERM
LINK COUP BLOQ 1 LECT bas1 bas2 TERM
          BLOQ 23 LECT bar TERM
ECRI COOR DEPL VITE ACCE FINT FEXT CONT ECRO TFRE 0.3E-3
     FICH ALIC TEMP FREQ 1
          POIN LECT na nb TERM
          ELEM LECT ea eb TERM
     FICH ALIC TFRE 1.0E-5
OPTI NOTE STEP IO
 AMOR QUAD 4.0 LINE 0.2
 CSTA 0.5
 LOG 1
CALC TINI 0. TEND 0.60E-3
*==================================================================
SUIT
Post-treatment (space curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 1
SCOU 62 'ro_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 2
SCOU 65 'vx_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR ROUG
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR ROUG
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR ROUG
LIST 65 AXES 1.0 'VELOC. [M/S]'
*
QUAL ECRO COMP 1 LECT ea   TERM REFE  9.78687E+5 TOLE 2.E-2
     ECRO COMP 1 LECT eb   TERM REFE  2.83485E+5 TOLE 2.E-2
     ECRO COMP 2 LECT ea   TERM REFE  9.85733E+0 TOLE 2.E-2
     ECRO COMP 2 LECT eb   TERM REFE  2.04129E+0 TOLE 2.E-2
*==================================================================
SUIT
Post-treatment (time curves from alice temps file)
ECHO
RESU ALIC TEMP GARD PSCR
SORT GRAP
PERF 'fec800t.pun'
AXTE 1.0 'Time [s]'
COUR 1 'p_ea'  ECRO COMP 1 ELEM LECT ea TERM
COUR 2 'ro_ea' ECRO COMP 2 ELEM LECT ea TERM
COUR 3 'vx_ea' VITE COMP 1 NOEU LECT na TERM
COUR 4 'p_eb'  ECRO COMP 1 ELEM LECT eb TERM
COUR 5 'ro_eb' ECRO COMP 2 ELEM LECT eb TERM
COUR 6 'vx_eb' VITE COMP 1 NOEU LECT nb TERM
TRAC 1 4 AXES 1.0 'PRESS. [PA]'
COLO NOIR NOIR
TRAC 2 5 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR NOIR
TRAC 3 6 AXES 1.0 'VELOC. [M/S]'
COLO NOIR NOIR
LIST 1 4 AXES 1.0 'PRESS. [PA]'
LIST 2 5 AXES 1.0 'DENS. [KG/M3]'
LIST 3 6 AXES 1.0 'VELOC. [M/S]'
*==================================================================
SUIT
Post treatment (BMPs from alice file)
ECHO
RESU ALIC GARD PSCR
OPTI PRIN
SORT VISU NSTO 61
PLAY
CAME   1 EYE   5.00000E-01  5.00000E-03  3.00015E-01
!        Q     1.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
         VIEW  0.00000E+00  0.00000E+00 -1.00000E+00
         RIGH  1.00000E+00  0.00000E+00  0.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   5.25000E+01
SCEN GEOM NAVI FREE
!         LINE HEOU
     ISO  FILL FIEL VITE SCAL USER PROG 20 PAS 20 280 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
SCEN GEOM NAVI FREE
!         LINE HEOU
     ISO  FILL FIEL ECRO 2 SCAL USER PROG 1 PAS 0.6 8.8 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
ENDPLAY
*==================================================================
FIN
```

fec801.dgibi

```
opti echo 1;
opti dime 3 elem cub8;
opti titr 'FEC801';
opti sauv form 'fec801.msh';
opti trac psc ftra 'fec801_mesh.ps';
p0 = 0 0 0;
dd = 0.01;
n = 100;
p1 = 0 dd 0;
p2 = 0 dd dd;
p3 =  0 0 dd;
c1 = p0 d 1 p1;
c2 = p1 d 1 p2;
c3 = p2 d 1 p3;
c4 = p3 d 1 p0;
base = dall c1 c2 c3 c4 plan;
bar = base volu n tran ((n*dd) 0 0);
mesh = bar;
tass mesh;
sauv form mesh;
trac qual cach mesh;
fin;
```

fec801.epx

```
FEC801
ECHO
!CONV win
CAST mesh
EULE TRID
DIME
  ADAP NPOI 1045 CUBE 712 ENDA
TERM
GEOM CUBE bar TERM
COMP GROU 4 'bar1' LECT 1 PAS 1 50 TERM
            'bar2' LECT 51 PAS 1 100 TERM
            'ea' LECT 26 TERM
            'eb' LECT 75 TERM
     NGRO 5 'xaxo' LECT bar TERM COND LINE X1 0 Y1 0 Z1 0
                                          X2 1 Y2 0 Z2 0 TOL 1.E-4
            'bas1' LECT bar TERM COND X LT 0.0001
            'bas2' LECT bar TERM COND X GT 0.9999
            'na'   LECT bar TERM COND NEAR POIN 0.25 0 0
            'nb'   LECT bar TERM COND NEAR POIN 0.75 0 0
     COUL ROUG LECT bar1 TERM
          VERT LECT bar2 TERM
WAVE 4 PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 613.568783589856 ! shock wave
            MAXL 3 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 295.278289836459 ! c.d. wave
            MAXL 3 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 18.2004723251679 ! r.wave (ri.)
            MAXL 3 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 Z 0 NX -1 NY 0 NZ 0 T0 0 C 387.298334620742 ! r. wav (le.)
            MAXL 3 H1 0.015 H2 0.05
MATE GAZP RO 10 GAMM 1.5 PINI 1.E6 PREF 1.E5
          LECT bar1 TERM
     GAZP RO  1 GAMM 1.5 PINI 1.E5 PREF 1.E5
          LECT bar2 _cube TERM
LINK COUP BLOQ 1 LECT bas1 bas2 TERM
```

```
        BLOQ 23 LECT bar TERM
ECRI COOR DEPL VITE ACCE FINT FEXT CONT ECRO TFRE 0.3E-3
     FICH ALIC TEMP FREQ 1
          POIN LECT na nb TERM
          ELEM LECT ea eb TERM
     FICH ALIC TFRE 1.0E-5
OPTI NOTE STEP IO
 AMOR QUAD 4.0 LINE 0.2
 CSTA 0.25
 LOG 1
CALC TINI 0. TEND 0.60E-3
*=================================================================
SUIT
Post-treatment (space curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 1
SCOU 62 'ro_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 2
SCOU 65 'vx_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR VERT
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR VERT
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR VERT
LIST 65 AXES 1.0 'VELOC. [M/S]'
*
QUAL ECRO COMP 1 LECT ea   TERM REFE  9.97352E+5 TOLE 2.E-2
     ECRO COMP 1 LECT eb   TERM REFE  2.83845E+5 TOLE 2.E-2
     ECRO COMP 2 LECT ea   TERM REFE  9.98273E+0 TOLE 2.E-2
     ECRO COMP 2 LECT eb   TERM REFE  2.02291E+0 TOLE 2.E-2
*=================================================================
SUIT
Post-treatment (time curves from alice temps file)
ECHO
RESU ALIC TEMP GARD PSCR
SORT GRAP
PERF 'fec801t.pun'
AXTE 1.0 'Time [s]'
COUR 1 'p_ea'  ECRO COMP 1 ELEM LECT ea TERM
COUR 2 'ro_ea' ECRO COMP 2 ELEM LECT ea TERM
COUR 3 'vx_ea' VITE COMP 1 NOEU LECT na TERM
COUR 4 'p_eb'  ECRO COMP 1 ELEM LECT eb TERM
COUR 5 'ro_eb' ECRO COMP 2 ELEM LECT eb TERM
COUR 6 'vx_eb' VITE COMP 1 NOEU LECT nb TERM
TRAC 1 4 AXES 1.0 'PRESS. [PA]'
COLO NOIR NOIR
TRAC 2 5 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR NOIR
TRAC 3 6 AXES 1.0 'VELOC. [M/S]'
COLO NOIR NOIR
LIST 1 4 AXES 1.0 'PRESS. [PA]'
LIST 2 5 AXES 1.0 'DENS. [KG/M3]'
LIST 3 6 AXES 1.0 'VELOC. [M/S]'
*=================================================================
SUIT
Post treatment (BMPs from alice file)
ECHO
RESU ALIC GARD PSCR
OPTI PRIN
SORT VISU NSTO 61
PLAY
CAME   1 EYE   5.00000E-01  5.00000E-03  3.00015E-01
!        Q     1.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
         VIEW  0.00000E+00  0.00000E+00 -1.00000E+00
         RIGH  1.00000E+00  0.00000E+00  0.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   5.25000E+01
SCEN GEOM NAVI FREE
!         LINE HEOU
     ISO  FILL FIEL VITE SCAL USER PROG 20 PAS 20 280 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
SCEN GEOM NAVI FREE
!         LINE HEOU
     ISO  FILL FIEL ECRO 2 SCAL USER PROG 1 PAS 0.6 8.8 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
ENDPLAY
*=================================================================
FIN
```

fequ00.dgibi

```
opti echo 0;
opti donn 'pxordpoi.proc';
opti echo 1;
opti dime 2 elem qua4;
opti sauv form 'fequ00.msh';
opti trac psc ftra 'fequ00_mesh.ps';
p0 = 0 0;
p0p = p0 plus (0 0.00125);
pmid = 0.5 0;
p1 = 1 0;
p1p = p1 plus (0 0.00125);
pa = 0.25 0;
pb = 0.75 0;
tol = 1.E-5;
n = 800;
n2 = n / 2;
n4 = n2 / 2;
c11 = p0 d n4 pa;
c12 = pa d n4 pmid;
c1 = c11 et c12;
c21 = pmid d n4 pb;
c22 = pb d n4 p1;
c2 = c21 et c22;
bar11 = c11 tran 1 (0 0.00125);
bar12 = c12 tran 1 (0 0.00125);
bar1 = bar11 et bar12;
bar21 = c21 tran 1 (0 0.00125);
bar22 = c22 tran 1 (0 0.00125);
bar2 = bar21 et bar22;
bar = bar1 et bar2;
elim tol (bar et p0p et p1p et pa et pb);
ea = bar1 elem cont pa;
eb = bar2 elem cont pb;
xax = chan 'POI1' (c1 et c2);
xaxo = pxordpoi xax p0;
mesh = bar et ea et eb et xaxo;
tass mesh;
sauv form mesh;
trac qual mesh;
trac ((cont mesh) et ea et eb);
fin;
```

fequ00.epx

```
FEQU00 (with mesh reduced to 800 x 1 x 2 to save CPU time)
ECHO
!CONV win
CAST mesh
EULE DPLA
GEOM CAR1 bar TERM
MATE GAZP RO 10 GAMM 1.5 PINI 1.E6 PREF 1.E5
          LECT bar1 TERM
     GAZP RO  1 GAMM 1.5 PINI 1.E5 PREF 1.E5
          LECT bar2 TERM
LINK COUP BLOQ 1 LECT p0 p0p p1 p1p TERM
          BLOQ 2 LECT bar TERM
ECRI COOR DEPL VITE ACCE FINT FEXT CONT ECRO TFRE 0.3E-3
     FICH ALIC TEMP FREQ 1
          POIN LECT pa pmid pb TERM
          ELEM LECT ea eb TERM
     FICH ALIC TFRE 1.0E-5
OPTI NOTE STEP IO
 AMOR QUAD 4.0 LINE 0.2
 csta 0.5
 log 1
CALC TINI 0. TEND 0.60E-3
*=================================================================
SUIT
Post-treatment (space curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
!PERF 'fequ00.pun'
AXTE 1.0 'Time [s]'
SCOU 61 'p_61'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 1
SCOU 62 'ro_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 2
SCOU 65 'vx_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR ROUG
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR ROUG
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR ROUG
LIST 65 AXES 1.0 'VELOC. [M/S]'
*
QUAL ECRO COMP 1 LECT ea   TERM REFE  9.99996E+5 TOLE 2.E-2
     ECRO COMP 1 LECT eb   TERM REFE  2.82943E+5 TOLE 2.E-2
     ECRO COMP 2 LECT ea   TERM REFE  9.99997E+0 TOLE 2.E-2
     ECRO COMP 2 LECT eb   TERM REFE  1.92000E+0 TOLE 2.E-2
*=================================================================
SUIT
Post treatment (BMPs from alice file)
ECHO
RESU ALIC GARD PSCR
OPTI PRIN
SORT VISU NSTO 61
PLAY
CAME   1 EYE   5.00000E-01  5.00000E-03  3.00015E-01
!        Q     1.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
         VIEW  0.00000E+00  0.00000E+00 -1.00000E+00
         RIGH  1.00000E+00  0.00000E+00  0.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   5.25000E+01
SCEN GEOM NAVI FREE
          LINE HEOU
     ISO  FILL FIEL VITE SCAL USER PROG 20 PAS 20 280 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
SCEN GEOM NAVI FREE
          LINE HEOU
     ISO  FILL FIEL ECRO 2 SCAL USER PROG 1 PAS 0.6 8.8 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
ENDPLAY
*=================================================================
FIN
```

fequ01.epx

```
FEQU01
ECHO
!CONV win
EULE DPLA
DIME
  ADAP NPOI 1000 CAR1 2000 ENDA
TERM
GEOM LIBR POIN 202 CAR1 100 TERM
 0.00 0.00  0.01 0.00  0.02 0.00  0.03 0.00  0.04 0.00  0.05 0.00
            0.06 0.00  0.07 0.00  0.08 0.00  0.09 0.00  0.10 0.00
            0.11 0.00  0.12 0.00  0.13 0.00  0.14 0.00  0.15 0.00
            0.16 0.00  0.17 0.00  0.18 0.00  0.19 0.00  0.20 0.00
            0.21 0.00  0.22 0.00  0.23 0.00  0.24 0.00  0.25 0.00
            0.26 0.00  0.27 0.00  0.28 0.00  0.29 0.00  0.30 0.00
            0.31 0.00  0.32 0.00  0.33 0.00  0.34 0.00  0.35 0.00
            0.36 0.00  0.37 0.00  0.38 0.00  0.39 0.00  0.40 0.00
            0.41 0.00  0.42 0.00  0.43 0.00  0.44 0.00  0.45 0.00
            0.46 0.00  0.47 0.00  0.48 0.00  0.49 0.00  0.50 0.00
            0.51 0.00  0.52 0.00  0.53 0.00  0.54 0.00  0.55 0.00
            0.56 0.00  0.57 0.00  0.58 0.00  0.59 0.00  0.60 0.00
            0.61 0.00  0.62 0.00  0.63 0.00  0.64 0.00  0.65 0.00
            0.66 0.00  0.67 0.00  0.68 0.00  0.69 0.00  0.70 0.00
            0.71 0.00  0.72 0.00  0.73 0.00  0.74 0.00  0.75 0.00
            0.76 0.00  0.77 0.00  0.78 0.00  0.79 0.00  0.80 0.00
            0.81 0.00  0.82 0.00  0.83 0.00  0.84 0.00  0.85 0.00
            0.86 0.00  0.87 0.00  0.88 0.00  0.89 0.00  0.90 0.00
            0.91 0.00  0.92 0.00  0.93 0.00  0.94 0.00  0.95 0.00
            0.96 0.00  0.97 0.00  0.98 0.00  0.99 0.00  1.00 0.00
 0.00 0.01  0.01 0.01  0.02 0.01  0.03 0.01  0.04 0.01  0.05 0.01
            0.06 0.01  0.07 0.01  0.08 0.01  0.09 0.01  0.10 0.01
            0.11 0.01  0.12 0.01  0.13 0.01  0.14 0.01  0.15 0.01
            0.16 0.01  0.17 0.01  0.18 0.01  0.19 0.01  0.20 0.01
            0.21 0.01  0.22 0.01  0.23 0.01  0.24 0.01  0.25 0.01
            0.26 0.01  0.27 0.01  0.28 0.01  0.29 0.01  0.30 0.01
            0.31 0.01  0.32 0.01  0.33 0.01  0.34 0.01  0.35 0.01
            0.36 0.01  0.37 0.01  0.38 0.01  0.39 0.01  0.40 0.01
            0.41 0.01  0.42 0.01  0.43 0.01  0.44 0.01  0.45 0.01
            0.46 0.01  0.47 0.01  0.48 0.01  0.49 0.01  0.50 0.01
            0.51 0.01  0.52 0.01  0.53 0.01  0.54 0.01  0.55 0.01
            0.56 0.01  0.57 0.01  0.58 0.01  0.59 0.01  0.60 0.01
            0.61 0.01  0.62 0.01  0.63 0.01  0.64 0.01  0.65 0.01
            0.66 0.01  0.67 0.01  0.68 0.01  0.69 0.01  0.70 0.01
            0.71 0.01  0.72 0.01  0.73 0.01  0.74 0.01  0.75 0.01
            0.76 0.01  0.77 0.01  0.78 0.01  0.79 0.01  0.80 0.01
            0.81 0.01  0.82 0.01  0.83 0.01  0.84 0.01  0.85 0.01
            0.86 0.01  0.87 0.01  0.88 0.01  0.89 0.01  0.90 0.01
            0.91 0.01  0.92 0.01  0.93 0.01  0.94 0.01  0.95 0.01
            0.96 0.01  0.97 0.01  0.98 0.01  0.99 0.01  1.00 0.01
   1   2 103 102
   2   3 104 103
   3   4 105 104
   4   5 106 105
   5   6 107 106
   6   7 108 107
   7   8 109 108
   8   9 110 109
   9  10 111 110
  10  11 112 111
  11  12 113 112
  12  13 114 113
  13  14 115 114
  14  15 116 115
  15  16 117 116
  16  17 118 117
  17  18 119 118
  18  19 120 119
  19  20 121 120
  20  21 122 121
  21  22 123 122
  22  23 124 123
  23  24 125 124
  24  25 126 125
  25  26 127 126
  26  27 128 127
  27  28 129 128
  28  29 130 129
  29  30 131 130
  30  31 132 131
  31  32 133 132
  32  33 134 133
  33  34 135 134
  34  35 136 135
  35  36 137 136
  36  37 138 137
  37  38 139 138
  38  39 140 139
  39  40 141 140
  40  41 142 141
  41  42 143 142
  42  43 144 143
  43  44 145 144
  44  45 146 145
  45  46 147 146
  46  47 148 147
  47  48 149 148
  48  49 150 149
  49  50 151 150
  50  51 152 151
  51  52 153 152
  52  53 154 153
  53  54 155 154
  54  55 156 155
  55  56 157 156
  56  57 158 157
  57  58 159 158
  58  59 160 159
  59  60 161 160
  60  61 162 161
  61  62 163 162
  62  63 164 163
  63  64 165 164
  64  65 166 165
  65  66 167 166
  66  67 168 167
  67  68 169 168
  68  69 170 169
  69  70 171 170
  70  71 172 171
  71  72 173 172
  72  73 174 173
  73  74 175 174
  74  75 176 175
  75  76 177 176
  76  77 178 177
  77  78 179 178
  78  79 180 179
  79  80 181 180
  80  81 182 181
  81  82 183 182
  82  83 184 183
  83  84 185 184
  84  85 186 185
  85  86 187 186
  86  87 188 187
  87  88 189 188
  88  89 190 189
  89  90 191 190
  90  91 192 191
  91  92 193 192
  92  93 194 193
  93  94 195 194
  94  95 196 195
  95  96 197 196
  96  97 198 197
  97  98 199 198
  98  99 200 199
  99 100 201 200
 100 101 202 201
COMP GROU 5 'bar1' LECT  1 PAS 1  50 TERM
            'bar2' LECT 51 PAS 1 100 TERM
            'bar'  LECT bar1 bar2 TERM
            'ea'   LECT 26 TERM
            'eb'   LECT 76 TERM
     NGRO 7 'p0'   LECT   1 TERM
            'p0p'  LECT 102 TERM
            'p1'   LECT 101 TERM
            'p1p'  LECT 202 TERM
            'pa'   LECT  26 TERM
            'pmid' LECT  51 TERM
            'pb'   LECT  76 TERM
WAVE 4 PLAN X 0.5 Y 0 NX 1 NY 0 T0 0 C 613.568783589856 ! shock wave
            MAXL 4 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 NX 1 NY 0 T0 0 C 295.278289836459 ! c.d. wave
            MAXL 4 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 NX 1 NY 0 T0 0 C 18.2004723251679 ! r.wave (right)
            MAXL 4 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 NX -1 NY 0 T0 0 C 387.298334620742 ! r. wave (left)
            MAXL 4 H1 0.015 H2 0.05
MATE GAZP RO 10 GAMM 1.5 PINI 1.E6 PREF 1.E5
          LECT bar1 TERM
     GAZP RO  1 GAMM 1.5 PINI 1.E5 PREF 1.E5
          LECT bar2 _car1 TERM
LINK COUP BLOQ 1 LECT p0 p0p p1 p1p TERM
          BLOQ 2 LECT bar TERM
ECRI COOR DEPL VITE ACCE FINT FEXT CONT ECRO TFRE 0.3E-3
     FICH ALIC TEMP FREQ 1
          POIN LECT pa pmid pb TERM
          ELEM LECT ea eb TERM
     FICH ALIC TFRE 1.0E-5
OPTI NOTE STEP IO
 AMOR QUAD 4.0 LINE 0.2
 csta 0.25
 log 1
CALC TINI 0. TEND 0.60E-3
*==================================================================
SUIT
Post-treatment (space curves from alice file)
ECHO
RESU ALIC GARD PSCR
COMP NGRO 1 'xaxo' LECT 1 PAS 1 101 TERM
SORT GRAP
!PERF 'fequ01.pun'
AXTE 1.0 'Time [s]'
*
* Attention: le SUPP /LECT/ est **mandatoire** dans les directives ci-dessous
* car sinon on risque de traiter les noeuds de l'element "bidon" comme
* faisant partie de l'abscisse curviligne (qui doit etre basee seulement
* sur les TRIA)
* En general, il est toujours une bonne idee de specifier le SUPPort,
* s'il y a des doutes ...
*
SCOU 61 'p_61'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        SUPP LECT bar TERM
                        ECRO COMP 1
SCOU 62 'ro_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        SUPP LECT bar TERM
                        ECRO COMP 2
SCOU 65 'vx_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        SUPP LECT bar TERM
                        VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR ROUG
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR ROUG
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR ROUG
LIST 65 AXES 1.0 'VELOC. [M/S]'
*
QUAL ECRO COMP 1 LECT ea   TERM REFE  9.99483E+5 TOLE 2.E-2
     ECRO COMP 1 LECT eb   TERM REFE  2.84565E+5 TOLE 2.E-2
     ECRO COMP 2 LECT ea   TERM REFE  9.99666E+0 TOLE 2.E-2
     ECRO COMP 2 LECT eb   TERM REFE  1.95743E+0 TOLE 2.E-2
*==================================================================
SUIT
```

```
Post treatment (BMPs from alice file)
ECHO
RESU ALIC GARD PSCR
OPTI PRIN
SORT VISU NSTO 61
PLAY
CAME   1 EYE   5.00000E-01  5.00000E-03  3.00015E-01
!        Q     1.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
         VIEW  0.00000E+00  0.00000E+00 -1.00000E+00
         RIGH  1.00000E+00  0.00000E+00  0.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   5.25000E+01
SCEN GEOM NAVI FREE
          LINE HEOU
     ISO  FILL FIEL VITE SCAL USER PROG 20 PAS 20 280 TERM
               SUPP LECT bar TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP OBJE LECT bar TERM REND
SCEN GEOM NAVI FREE
          LINE HEOU
     ISO  FILL FIEL ECRO 2 SCAL USER PROG 1 PAS 0.6 8.8 TERM
               SUPP LECT bar TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP OBJE LECT bar TERM REND
ENDPLAY
*==================================================================
FIN
```

fet400.dgibi

```
opti echo 1;
opti donn 'pxhex2te.proc';
opti dime 3 elem cub8;
opti titr 'FET400';
opti sauv form 'fet400.msh';
opti trac psc ftra 'fet400_mesh.ps';
p0 = 0 0 0;
dd = 0.01;
n = 100;
tol = 0.0001;
p1 = 0 dd 0;
p2 = 0 dd dd;
p3 =  0 0 dd;
c1 = p0 d 1 p1;
c2 = p1 d 1 p2;
c3 = p2 d 1 p3;
c4 = p3 d 1 p0;
base = dall c1 c2 c3 c4 plan;
bar8 = base volu n tran ((n*dd) 0 0);
i = 0;
repe loop1 (nbel bar8);
  i = i + 1;
  cubei = bar8 elem i;
  tt = pxhex2te cubei;
  si (ega i 1);
    bar = tt;
  sinon;
    bar = bar et tt;
  finsi;
fin loop1;
elim tol bar;
mesh = bar;
tass mesh;
sauv form mesh;
trac qual cach mesh;
fin;
```

fet400.epx

```
FET400
ECHO
!CONV win
CAST mesh
EULE TRID
GEOM TETR bar TERM
COMP GROU 4 'bar1' LECT bar TERM COND XB LT 0.5
            'bar2' LECT bar DIFF bar1 TERM
            'ea' LECT bar TERM COND NEAR POIN 0.25 0 0
            'eb' LECT bar TERM COND NEAR POIN 0.75 0 0
     NGRO 5 'xaxo' LECT bar TERM COND LINE X1 0 Y1 0 Z1 0
                                           X2 1 Y2 0 Z2 0 TOL 1.E-4
            'bas1' LECT bar TERM COND X LT 0.0001
            'bas2' LECT bar TERM COND X GT 0.9999
            'na'   LECT bar TERM COND NEAR POIN 0.25 0 0
            'nb'   LECT bar TERM COND NEAR POIN 0.75 0 0
     COUL ROUG LECT bar1 TERM
          VERT LECT bar2 TERM
MATE GAZP RO 10 GAMM 1.5 PINI 1.E6 PREF 1.E5
          LECT bar1 TERM
     GAZP RO  1 GAMM 1.5 PINI 1.E5 PREF 1.E5
          LECT bar2 TERM
LINK COUP BLOQ 1 LECT bas1 bas2 TERM
          BLOQ 23 LECT bar TERM
ECRI COOR DEPL VITE ACCE FINT FEXT CONT ECRO VFCC TFRE 0.3E-3
     FICH ALIC TEMP FREQ 1
          POIN LECT na nb TERM
          ELEM LECT ea eb TERM
     FICH ALIC TFRE 1.0E-5
OPTI NOTE STEP IO
 AMOR QUAD 4.0 LINE 0.2
 CSTA 0.5
 LOG 1
CALC TINI 0. TEND 0.60E-3
*==================================================================
SUIT
Post-treatment (space curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 1
SCOU 62 'ro_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 2
SCOU 65 'vx_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR ROUG
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR ROUG
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR ROUG
LIST 65 AXES 1.0 'VELOC. [M/S]'
*
QUAL ECRO COMP 1 LECT ea   TERM REFE  9.93949E+5 TOLE 2.E-2
     ECRO COMP 1 LECT eb   TERM REFE  2.83193E+5 TOLE 2.E-2
     ECRO COMP 2 LECT ea   TERM REFE  9.95962E+0 TOLE 2.E-2
     ECRO COMP 2 LECT eb   TERM REFE  1.90911E+0 TOLE 2.E-2
*==================================================================
SUIT
Post-treatment (time curves from alice temps file)
ECHO
RESU ALIC TEMP GARD PSCR
SORT GRAP
PERF 'fet400t.pun'
AXTE 1.0 'Time [s]'
COUR 1 'p_ea'  ECRO COMP 1 ELEM LECT ea TERM
COUR 2 'ro_ea' ECRO COMP 2 ELEM LECT ea TERM
COUR 3 'vx_ea' VITE COMP 1 NOEU LECT na TERM
COUR 4 'p_eb'  ECRO COMP 1 ELEM LECT eb TERM
COUR 5 'ro_eb' ECRO COMP 2 ELEM LECT eb TERM
COUR 6 'vx_eb' VITE COMP 1 NOEU LECT nb TERM
TRAC 1 4 AXES 1.0 'PRESS. [PA]'
COLO NOIR NOIR
TRAC 2 5 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR NOIR
TRAC 3 6 AXES 1.0 'VELOC. [M/S]'
COLO NOIR NOIR
LIST 1 4 AXES 1.0 'PRESS. [PA]'
LIST 2 5 AXES 1.0 'DENS. [KG/M3]'
LIST 3 6 AXES 1.0 'VELOC. [M/S]'
*==================================================================
SUIT
Post treatment (BMPs from alice file)
ECHO
RESU ALIC GARD PSCR
OPTI PRIN
SORT VISU NSTO 61
PLAY
CAME   1 EYE   5.00000E-01  5.00000E-03  3.00015E-01
!        Q     1.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
         VIEW  0.00000E+00  0.00000E+00 -1.00000E+00
         RIGH  1.00000E+00  0.00000E+00  0.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   5.25000E+01
SCEN GEOM NAVI FREE
!         LINE HEOU
     ISO  FILL FIEL VITE SCAL USER PROG 20 PAS 20 280 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
SCEN GEOM NAVI FREE
!         LINE HEOU
     ISO  FILL FIEL ECRO 2 SCAL USER PROG 1 PAS 0.6 8.8 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
ENDPLAY
*==================================================================
FIN
```

fet401.dgibi

```
opti echo 1;
opti donn 'pxhex2te.proc';
opti dime 3 elem cub8;
opti titr 'FET401';
opti sauv form 'fet401.msh';
opti trac psc ftra 'fet401_mesh.ps';
p0 = 0 0 0;
dd = 0.01;
n = 100;
tol = 0.0001;
p1 = 0 dd 0;
p2 = 0 dd dd;
p3 =  0 0 dd;
c1 = p0 d 1 p1;
c2 = p1 d 1 p2;
c3 = p2 d 1 p3;
c4 = p3 d 1 p0;
base = dall c1 c2 c3 c4 plan;
bar8 = base volu n tran ((n*dd) 0 0);
i = 0;
repe loop1 (nbel bar8);
  i = i + 1;
  cubei = bar8 elem i;
  tt = pxhex2te cubei;
  si (ega i 1);
    bar = tt;
  sinon;
    bar = bar et tt;
  finsi;
fin loop1;
elim tol bar;
barsur = chan poi1 (enve bar);
```

```
mesh = bar et barsur;
tass mesh;
sauv form mesh;
trac qual cach mesh;
fin;
```

fet401.epx

```
FET401
ECHO
!CONV win
CAST mesh
EULE TRID
DIME
  ADAP NPOI 1648 TETR 7872 ENDA
TERM
GEOM TETR bar TERM
COMP GROU 4 'bar1' LECT bar TERM COND XB LT 0.5
            'bar2' LECT bar DIFF bar1 TERM
            'ea' LECT bar TERM COND NEAR POIN 0.25 0 0
            'eb' LECT bar TERM COND NEAR POIN 0.75 0 0
     NGRO 5 'xaxo' LECT bar TERM COND LINE X1 0 Y1 0 Z1 0
                                           X2 1 Y2 0 Z2 0 TOL 1.E-4
            'bas1' LECT bar TERM COND X LT 0.0001
            'bas2' LECT bar TERM COND X GT 0.9999
            'na'   LECT bar TERM COND NEAR POIN 0.25 0 0
            'nb'   LECT bar TERM COND NEAR POIN 0.75 0 0
     COUL ROUG LECT bar1 TERM
          VERT LECT bar2 TERM
WAVE 4 PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 613.568783589856 ! shock wave
            MAXL 3 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 295.278289836459 ! c.d. wave
            MAXL 3 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 18.2004723251679 ! r.wave (ri.)
            MAXL 3 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 Z 0 NX -1 NY 0 NZ 0 T0 0 C 387.298334620742 ! r. wav (le.)
            MAXL 3 H1 0.015 H2 0.05
MATE GAZP RO 10 GAMM 1.5 PINI 1.E6 PREF 1.E5
          LECT bar1 TERM
     GAZP RO  1 GAMM 1.5 PINI 1.E5 PREF 1.E5
          LECT bar2 _tetr TERM
LINK COUP BLOQ 1 LECT bas1 bas2 TERM
          BLOQ 23 LECT barsur TERM
ECRI COOR DEPL VITE ACCE FINT FEXT CONT ECRO TFRE 0.3E-3
     FICH ALIC TEMP FREQ 1
          POIN LECT na nb TERM
          ELEM LECT ea eb TERM
     FICH ALIC TFRE 1.0E-5
OPTI NOTE STEP IO
 AMOR QUAD 4.0 LINE 0.2
 CSTA 0.125
 LOG 1
CALC TINI 0. TEND 0.60E-3
*=================================================================
SUIT
Post-treatment (space curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 1
SCOU 62 'ro_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 2
SCOU 65 'vx_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                  TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                  TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                  TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR VERT
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR VERT
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR VERT
LIST 65 AXES 1.0 'VELOC. [M/S]'
*
QUAL ECRO COMP 1 LECT ea   TERM REFE  9.99590E+5 TOLE 2.E-2
     ECRO COMP 1 LECT eb   TERM REFE  2.82972E+5 TOLE 2.E-2
     ECRO COMP 2 LECT ea   TERM REFE  9.99726E+0 TOLE 2.E-2
     ECRO COMP 2 LECT eb   TERM REFE  1.92972E+0 TOLE 2.E-2
*=================================================================
SUIT
Post-treatment (time curves from alice temps file)
ECHO
RESU ALIC TEMP GARD PSCR
SORT GRAP
PERF 'fet401t.pun'
AXTE 1.0 'Time [s]'
COUR 1 'p_ea'  ECRO COMP 1 ELEM LECT ea TERM
COUR 2 'ro_ea' ECRO COMP 2 ELEM LECT ea TERM
COUR 3 'vx_ea' VITE COMP 1 NOEU LECT na TERM
COUR 4 'p_eb'  ECRO COMP 1 ELEM LECT eb TERM
COUR 5 'ro_eb' ECRO COMP 2 ELEM LECT eb TERM
COUR 6 'vx_eb' VITE COMP 1 NOEU LECT nb TERM
TRAC 1 4 AXES 1.0 'PRESS. [PA]'
COLO NOIR NOIR
TRAC 2 5 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR NOIR
TRAC 3 6 AXES 1.0 'VELOC. [M/S]'
COLO NOIR NOIR
LIST 1 4 AXES 1.0 'PRESS. [PA]'
LIST 2 5 AXES 1.0 'DENS. [KG/M3]'
LIST 3 6 AXES 1.0 'VELOC. [M/S]'
*=================================================================
SUIT
Post treatment (BMPs from alice file)
ECHO
RESU ALIC GARD PSCR
OPTI PRIN
SORT VISU NSTO 61
PLAY
CAME   1 EYE   5.00000E-01  5.00000E-03  3.00015E-01
!        Q     1.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
         VIEW  0.00000E+00  0.00000E+00 -1.00000E+00
         RIGH  1.00000E+00  0.00000E+00  0.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   5.25000E+01
SCEN GEOM NAVI FREE
!        LINE HEOU
     ISO  FILL FIEL VITE SCAL USER PROG 20 PAS 20 280 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
SCEN GEOM NAVI FREE
!        LINE HEOU
     ISO  FILL FIEL ECRO 2 SCAL USER PROG 1 PAS 0.6 8.8 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
ENDPLAY
*=================================================================
FIN
```

fet402.dgibi

```
opti echo 1;
opti donn 'pxhex2t2.proc';
opti dime 3 elem cub8;
opti titr 'FET402';
opti sauv form 'fet402.msh';
opti trac psc ftra 'fet402_mesh.ps';
p0 = 0 0 0;
dd = 0.01;
n = 100;
tol = 0.0001;
p1 = 0 dd 0;
p2 = 0 dd dd;
p3 =  0 0 dd;
c1 = p0 d 1 p1;
c2 = p1 d 1 p2;
c3 = p2 d 1 p3;
c4 = p3 d 1 p0;
base = dall c1 c2 c3 c4 plan;
bar8 = base volu n tran ((n*dd) 0 0);
i = 0;
repe loop1 (nbel bar8);
  i = i + 1;
  cubei = bar8 elem i;
  tt = pxhex2t2 cubei;
  si (ega i 1);
    bar = tt;
  sinon;
    bar = bar et tt;
  finsi;
fin loop1;
elim tol bar;
barsur = chan poi1 (enve bar);
mesh = bar et barsur;
tass mesh;
sauv form mesh;
trac qual cach mesh;
fin;
```

fet402.epx

```
FET402
ECHO
!CONV win
CAST mesh
EULE TRID
DIME
  ADAP NPOI 3189 TETR 15712 ENDA
TERM
GEOM TETR bar TERM
COMP GROU 4 'bar1' LECT bar TERM COND XB LT 0.5
            'bar2' LECT bar DIFF bar1 TERM
            'ea' LECT bar TERM COND NEAR POIN 0.25 0 0
            'eb' LECT bar TERM COND NEAR POIN 0.75 0 0
     NGRO 5 'xaxo' LECT bar TERM COND LINE X1 0 Y1 0 Z1 0
                                           X2 1 Y2 0 Z2 0 TOL 1.E-4
            'bas1' LECT bar TERM COND X LT 0.0001
            'bas2' LECT bar TERM COND X GT 0.9999
            'na'   LECT bar TERM COND NEAR POIN 0.25 0 0
            'nb'   LECT bar TERM COND NEAR POIN 0.75 0 0
     COUL ROUG LECT bar1 TERM
          VERT LECT bar2 TERM
WAVE 4 PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 613.568783589856 ! shock wave
            MAXL 3 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 295.278289836459 ! c.d. wave
            MAXL 3 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 18.2004723251679 ! r.wave (ri.)
            MAXL 3 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 Z 0 NX -1 NY 0 NZ 0 T0 0 C 387.298334620742 ! r. wav (le.)
            MAXL 3 H1 0.015 H2 0.05
MATE GAZP RO 10 GAMM 1.5 PINI 1.E6 PREF 1.E5
          LECT bar1 TERM
     GAZP RO  1 GAMM 1.5 PINI 1.E5 PREF 1.E5
          LECT bar2 _tetr TERM
LINK COUP BLOQ 1 LECT bas1 bas2 TERM
          BLOQ 23 LECT barsur TERM
ECRI COOR DEPL VITE ACCE FINT FEXT CONT ECRO TFRE 0.3E-3
     FICH ALIC TEMP FREQ 1
          POIN LECT na nb TERM
          ELEM LECT ea eb TERM
     FICH ALIC TFRE 1.0E-5
OPTI NOTE STEP IO
 AMOR QUAD 4.0 LINE 0.2
 CSTA 0.125
 LOG 1
CALC TINI 0. TEND 0.60E-3
*=================================================================
```

```
SUIT
Post-treatment (space curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 1
SCOU 62 'ro_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 2
SCOU 65 'vx_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR VERT
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR VERT
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR VERT
LIST 65 AXES 1.0 'VELOC. [M/S]'
*
QUAL ECRO COMP 1 LECT ea   TERM REFE  9.99014E+5 TOLE 2.E-2
     ECRO COMP 1 LECT eb   TERM REFE  2.83201E+5 TOLE 2.E-2
     ECRO COMP 2 LECT ea   TERM REFE  9.99359E+0 TOLE 2.E-2
     ECRO COMP 2 LECT eb   TERM REFE  1.92907E+0 TOLE 2.E-2
*=================================================================
SUIT
Post-treatment (time curves from alice temps file)
ECHO
RESU ALIC TEMP GARD PSCR
SORT GRAP
PERF 'fet402t.pun'
AXTE 1.0 'Time [s]'
COUR 1 'p_ea'  ECRO COMP 1 ELEM LECT ea TERM
COUR 2 'ro_ea' ECRO COMP 2 ELEM LECT ea TERM
COUR 3 'vx_ea' VITE COMP 1 NOEU LECT na TERM
COUR 4 'p_eb'  ECRO COMP 1 ELEM LECT eb TERM
COUR 5 'ro_eb' ECRO COMP 2 ELEM LECT eb TERM
COUR 6 'vx_eb' VITE COMP 1 NOEU LECT nb TERM
TRAC 1 4 AXES 1.0 'PRESS. [PA]'
COLO NOIR NOIR
TRAC 2 5 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR NOIR
TRAC 3 6 AXES 1.0 'VELOC. [M/S]'
COLO NOIR NOIR
LIST 1 4 AXES 1.0 'PRESS. [PA]'
LIST 2 5 AXES 1.0 'DENS. [KG/M3]'
LIST 3 6 AXES 1.0 'VELOC. [M/S]'
*=================================================================
SUIT
Post treatment (BMPs from alice file)
ECHO
RESU ALIC GARD PSCR
OPTI PRIN
SORT VISU NSTO 61
PLAY
CAME   1 EYE   5.00000E-01  5.00000E-03  3.00015E-01
!        Q     1.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
         VIEW  0.00000E+00  0.00000E+00 -1.00000E+00
         RIGH  1.00000E+00  0.00000E+00  0.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   5.25000E+01
SCEN GEOM NAVI FREE
!         LINE HEOU
     ISO  FILL FIEL VITE SCAL USER PROG 20 PAS 20 280 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
SCEN GEOM NAVI FREE
!         LINE HEOU
     ISO  FILL FIEL ECRO 2 SCAL USER PROG 1 PAS 0.6 8.8 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
ENDPLAY
*=================================================================
FIN
```

fet402a.epx

```
FET402A
ECHO
RESU ALIC 'fet402.ali' GARD PSCR
COMP NGRO 4 'xaxo' LECT bar TERM COND LINE X1 0 Y1   0 Z1   0
                                           X2 1 Y2   0 Z2   0 TOL 1.E-4
            'xaxp' LECT bar TERM COND LINE X1 0 Y1 .01 Z1   0
                                           X2 1 Y2 .01 Z2   0 TOL 1.E-4
            'xaxq' LECT bar TERM COND LINE X1 0 Y1 .01 Z1 .01
                                           X2 1 Y2 .01 Z2 .01 TOL 1.E-4
            'xaxr' LECT bar TERM COND LINE X1 0 Y1   0 Z1 .01
                                           X2 1 Y2   0 Z2 .01 TOL 1.E-4
SORT VISU NSTO 61
FIN
```

fet402b.epx

```
FET402B
ECHO
OPTI PRIN
RESU ALIC 'fet402.ali' GARD PSCR
COMP NGRO 4 'xaxo' LECT bar TERM COND LINE X1 0 Y1   0 Z1   0
                                           X2 1 Y2   0 Z2   0 TOL 1.E-4
            'xaxp' LECT bar TERM COND LINE X1 0 Y1 .01 Z1   0
                                           X2 1 Y2 .01 Z2   0 TOL 1.E-4
            'xaxq' LECT bar TERM COND LINE X1 0 Y1 .01 Z1 .01
                                           X2 1 Y2 .01 Z2 .01 TOL 1.E-4
            'xaxr' LECT bar TERM COND LINE X1 0 Y1   0 Z1 .01
                                           X2 1 Y2   0 Z2 .01 TOL 1.E-4
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61o'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 1
SCOU 62 'ro_61o' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 2
SCOU 65 'vx_61o' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         VITE COMP 1
SCOU 161 'p_61p'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 1
SCOU 162 'ro_61p' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 2
SCOU 165 'vx_61p' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         VITE COMP 1
SCOU 261 'p_61q'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 1
SCOU 262 'ro_61q' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 2
SCOU 265 'vx_61q' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         VITE COMP 1
SCOU 361 'p_61r'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 1
SCOU 362 'ro_61r' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 2
SCOU 365 'vx_61r' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR BLEU TURQ VERT ROUG
LIST 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
TRAC 62 162 262 362 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR BLEU TURQ VERT ROUG
TRAC 65 165 265 365 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR BLEU TURQ VERT ROUG
FIN
```

fet402c.epx

```
FET402C
ECHO
OPTI PRIN
RESU ALIC 'fet402.ali' GARD PSCR
COMP NGRO 4 'xaxo' LECT bar TERM COND LINE X1 0 Y1   0 Z1   0
                                           X2 1 Y2   0 Z2   0 TOL 1.E-4
            'xaxp' LECT bar TERM COND LINE X1 0 Y1 .01 Z1   0
                                           X2 1 Y2 .01 Z2   0 TOL 1.E-4
            'xaxq' LECT bar TERM COND LINE X1 0 Y1 .01 Z1 .01
                                           X2 1 Y2 .01 Z2 .01 TOL 1.E-4
            'xaxr' LECT bar TERM COND LINE X1 0 Y1   0 Z1 .01
                                           X2 1 Y2   0 Z2 .01 TOL 1.E-4
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61o'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 1
SCOU 62 'ro_61o' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 2
SCOU 65 'vx_61o' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         VITE COMP 1
SCOU 161 'p_61p'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 1
SCOU 162 'ro_61p' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 2
SCOU 165 'vx_61p' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         VITE COMP 1
SCOU 261 'p_61q'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 1
SCOU 262 'ro_61q' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 2
SCOU 265 'vx_61q' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         VITE COMP 1
SCOU 361 'p_61r'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 1
SCOU 362 'ro_61r' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 2
SCOU 365 'vx_61r' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.0E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.0E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.0E-3 NRAR 30 VARI 5
TRAC 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR BLEU TURQ VERT ROUG
LIST 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
TRAC 62 162 262 362 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR BLEU TURQ VERT ROUG
TRAC 65 165 265 365 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR BLEU TURQ VERT ROUG
TRAC 161 71 AXES 1.0 'PRESS. [PA]'
COLO BLEU ROUG
TRAC 162 72 AXES 1.0 'DENS. [KG/M3]'
COLO BLEU ROUG
TRAC 165 75 AXES 1.0 'VELOC. [M/S]'
COLO BLEU ROUG
TRAC 161 AXES 1.0 'PRESS. [PA]'
COLO BLEU
TRAC 162 AXES 1.0 'DENS. [KG/M3]'
COLO BLEU
TRAC 165 AXES 1.0 'VELOC. [M/S]'
COLO BLEU
FIN
```

fet403.dgibi

```
opti echo 1;
opti donn 'pxhex2t2.proc';
opti dime 3 elem cub8;
opti titr 'FET403';
opti sauv form 'fet403.msh';
opti trac psc ftra 'fet403_mesh.ps';
p0 = 0 0 0;
dd = 0.01;
n = 100;
tol = 0.0001;
p1 = 0 dd 0;
p2 = 0 dd dd;
p3 =  0 0 dd;
c1 = p0 d 1 p1;
c2 = p1 d 1 p2;
c3 = p2 d 1 p3;
c4 = p3 d 1 p0;
base = dall c1 c2 c3 c4 plan;
bar8 = base volu n tran ((n*dd) 0 0);
i = 0;
repe loop1 (nbel bar8);
  i = i + 1;
  cubei = bar8 elem i;
  tt = pxhex2t2 cubei;
  si (ega i 1);
    bar = tt;
  sinon;
    bar = bar et tt;
  finsi;
fin loop1;
elim tol bar;
barsur = chan poi1 (enve bar);
mesh = bar et barsur;
tass mesh;
sauv form mesh;
trac qual cach mesh;
fin;
```

fet403.epx

```
FET403
ECHO
!CONV win
CAST mesh
EULE TRID
DIME
  ADAP NPOI 4208 TETR 19200 ENDA
TERM
GEOM TETR bar TERM
COMP GROU 4 'bar1' LECT bar TERM COND XB LT 0.5
            'bar2' LECT bar DIFF bar1 TERM
            'ea' LECT bar TERM COND NEAR POIN 0.25 0 0
            'eb' LECT bar TERM COND NEAR POIN 0.75 0 0
     NGRO 5 'xaxo' LECT bar TERM COND LINE X1 0 Y1 0 Z1 0
                                          X2 1 Y2 0 Z2 0 TOL 1.E-4
            'bas1' LECT bar TERM COND X LT 0.0001
            'bas2' LECT bar TERM COND X GT 0.9999
            'na'   LECT bar TERM COND NEAR POIN 0.25 0 0
            'nb'   LECT bar TERM COND NEAR POIN 0.75 0 0
     COUL ROUG LECT bar1 TERM
          VERT LECT bar2 TERM
MATE GAZP RO 10 GAMM 1.5 PINI 1.E6 PREF 1.E5
          LECT bar1 TERM
     GAZP RO  1 GAMM 1.5 PINI 1.E5 PREF 1.E5
          LECT bar2 _tetr TERM
INIT ADAP SPLI LEVE 2 LECT bar TERM
LINK COUP BLOQ 1 LECT bas1 bas2 TERM
          BLOQ 23 LECT barsur TERM
ECRI COOR DEPL VITE ACCE FINT FEXT CONT ECRO TFRE 0.3E-3
     FICH ALIC TEMP FREQ 1
          POIN LECT na nb TERM
          ELEM LECT ea eb TERM
     FICH ALIC TFRE 1.0E-5
OPTI NOTE STEP IO
 AMOR QUAD 4.0 LINE 0.2
 CSTA 0.5
 LOG 1
CALC TINI 0. TEND 0.60E-3
*==================================================================
SUIT
Post-treatment (space curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 1
SCOU 62 'ro_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 2
SCOU 65 'vx_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR VERT
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR VERT
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR VERT
LIST 65 AXES 1.0 'VELOC. [M/S]'
*
QUAL ECRO COMP 1 LECT ea   TERM REFE  9.95808E+5 TOLE 2.E-2
     ECRO COMP 1 LECT eb   TERM REFE  2.82388E+5 TOLE 2.E-2
     ECRO COMP 2 LECT ea   TERM REFE  9.97203E+0 TOLE 2.E-2
     ECRO COMP 2 LECT eb   TERM REFE  1.90880E+0 TOLE 2.E-2
*==================================================================
SUIT
Post-treatment (time curves from alice temps file)
ECHO
RESU ALIC TEMP GARD PSCR
SORT GRAP
PERF 'fet403t.pun'
AXTE 1.0 'Time [s]'
COUR 1 'p_ea'  ECRO COMP 1 ELEM LECT ea TERM
COUR 2 'ro_ea' ECRO COMP 2 ELEM LECT ea TERM
COUR 3 'vx_ea' VITE COMP 1 NOEU LECT na TERM
COUR 4 'p_eb'  ECRO COMP 1 ELEM LECT eb TERM
COUR 5 'ro_eb' ECRO COMP 2 ELEM LECT eb TERM
COUR 6 'vx_eb' VITE COMP 1 NOEU LECT nb TERM
TRAC 1 4 AXES 1.0 'PRESS. [PA]'
COLO NOIR NOIR
TRAC 2 5 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR NOIR
TRAC 3 6 AXES 1.0 'VELOC. [M/S]'
COLO NOIR NOIR
LIST 1 4 AXES 1.0 'PRESS. [PA]'
LIST 2 5 AXES 1.0 'DENS. [KG/M3]'
LIST 3 6 AXES 1.0 'VELOC. [M/S]'
*==================================================================
SUIT
Post treatment (BMPs from alice file)
ECHO
RESU ALIC GARD PSCR
OPTI PRIN
SORT VISU NSTO 61
PLAY
CAME   1 EYE   5.00000E-01  5.00000E-03  3.00015E-01
!        Q     1.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
         VIEW  0.00000E+00  0.00000E+00 -1.00000E+00
         RIGH  1.00000E+00  0.00000E+00  0.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   5.25000E+01
SCEN GEOM NAVI FREE
!        LINE HEOU
     ISO  FILL FIEL VITE SCAL USER PROG 20 PAS 20 280 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
SCEN GEOM NAVI FREE
!        LINE HEOU
     ISO  FILL FIEL ECRO 2 SCAL USER PROG 1 PAS 0.6 8.8 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
ENDPLAY
*==================================================================
FIN
```

fet403a.epx

```
FET403A
ECHO
RESU ALIC 'fet403.ali' GARD PSCR
COMP NGRO 4 'xaxo' LECT bar TERM COND LINE X1 0 Y1   0 Z1   0
                                          X2 1 Y2   0 Z2   0 TOL 1.E-4
            'xaxp' LECT bar TERM COND LINE X1 0 Y1 .01 Z1   0
                                          X2 1 Y2 .01 Z2   0 TOL 1.E-4
            'xaxq' LECT bar TERM COND LINE X1 0 Y1 .01 Z1 .01
                                          X2 1 Y2 .01 Z2 .01 TOL 1.E-4
            'xaxr' LECT bar TERM COND LINE X1 0 Y1   0 Z1 .01
                                          X2 1 Y2   0 Z2 .01 TOL 1.E-4
SORT VISU NSTO 61
FIN
```

fet403b.epx

```
FET403B
ECHO
OPTI PRIN
RESU ALIC 'fet403.ali' GARD PSCR
COMP NGRO 4 'xaxo' LECT bar TERM COND LINE X1 0 Y1   0 Z1   0
                                          X2 1 Y2   0 Z2   0 TOL 1.E-4
            'xaxp' LECT bar TERM COND LINE X1 0 Y1 .01 Z1   0
                                          X2 1 Y2 .01 Z2   0 TOL 1.E-4
            'xaxq' LECT bar TERM COND LINE X1 0 Y1 .01 Z1 .01
                                          X2 1 Y2 .01 Z2 .01 TOL 1.E-4
            'xaxr' LECT bar TERM COND LINE X1 0 Y1   0 Z1 .01
                                          X2 1 Y2   0 Z2 .01 TOL 1.E-4
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61o'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 1
SCOU 62 'ro_61o' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 2
SCOU 65 'vx_61o' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         VITE COMP 1
SCOU 161 'p_61p'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 1
SCOU 162 'ro_61p' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 2
SCOU 165 'vx_61p' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         VITE COMP 1
SCOU 261 'p_61q'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 1
SCOU 262 'ro_61q' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 2
SCOU 265 'vx_61q' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         VITE COMP 1
SCOU 361 'p_61r'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 1
SCOU 362 'ro_61r' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 2
SCOU 365 'vx_61r' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
```

```
                    TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                    TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR BLEU TURQ VERT ROUG
LIST 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
TRAC 62 162 262 362 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR BLEU TURQ VERT ROUG
TRAC 65 165 265 365 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR BLEU TURQ VERT ROUG
FIN
```

fet403c.epx

```
FET403C
ECHO
OPTI PRIN
RESU ALIC 'fet403.ali' GARD PSCR
COMP NGRO 4 'xaxo' LECT bar TERM COND LINE X1 0 Y1   0 Z1   0
                                           X2 1 Y2   0 Z2   0 TOL 1.E-4
            'xaxp' LECT bar TERM COND LINE X1 0 Y1 .01 Z1   0
                                           X2 1 Y2 .01 Z2   0 TOL 1.E-4
            'xaxq' LECT bar TERM COND LINE X1 0 Y1 .01 Z1 .01
                                           X2 1 Y2 .01 Z2 .01 TOL 1.E-4
            'xaxr' LECT bar TERM COND LINE X1 0 Y1   0 Z1 .01
                                           X2 1 Y2   0 Z2 .01 TOL 1.E-4
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61o'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 1
SCOU 62 'ro_61o' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 2
SCOU 65 'vx_61o' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         VITE COMP 1
SCOU 161 'p_61p'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 1
SCOU 162 'ro_61p' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 2
SCOU 165 'vx_61p' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         VITE COMP 1
SCOU 261 'p_61q'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 1
SCOU 262 'ro_61q' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 2
SCOU 265 'vx_61q' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         VITE COMP 1
SCOU 361 'p_61r'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 1
SCOU 362 'ro_61r' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 2
SCOU 365 'vx_61r' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                    TIME 0.0E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                    TIME 0.0E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                    TIME 0.0E-3 NRAR 30 VARI 5
TRAC 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR BLEU TURQ VERT ROUG
LIST 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
TRAC 62 162 262 362 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR BLEU TURQ VERT ROUG
TRAC 65 165 265 365 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR BLEU TURQ VERT ROUG
TRAC 161 71 AXES 1.0 'PRESS. [PA]'
COLO BLEU ROUG
TRAC 162 72 AXES 1.0 'DENS. [KG/M3]'
COLO BLEU ROUG
TRAC 165 75 AXES 1.0 'VELOC. [M/S]'
COLO BLEU ROUG
TRAC 161 AXES 1.0 'PRESS. [PA]'
COLO BLEU
TRAC 162 AXES 1.0 'DENS. [KG/M3]'
COLO BLEU
TRAC 165 AXES 1.0 'VELOC. [M/S]'
COLO BLEU
FIN
```

fet404.dgibi

```
opti echo 1;
opti donn 'pxhex2t2.proc';
opti dime 3 elem cub8;
opti titr 'FET404';
opti sauv form 'fet404.msh';
opti trac psc ftra 'fet404_mesh.ps';
p0 = 0 0 0;
dd = 0.01;
n = 100;
tol = 0.0001;
p1 = 0 dd 0;
p2 = 0 dd dd;
p3 =  0 0 dd;
c1 = p0 d 1 p1;
c2 = p1 d 1 p2;
c3 = p2 d 1 p3;
c4 = p3 d 1 p0;
base = dall c1 c2 c3 c4 plan;
bar8 = base volu n tran ((n*dd) 0 0);
i = 0;
repe loop1 (nbel bar8);
  i = i + 1;
  cubei = bar8 elem i;
  tt = pxhex2t2 cubei;
  si (ega i 1);
    bar = tt;
  sinon;
    bar = bar et tt;
  finsi;
fin loop1;
elim tol bar;
barsur = chan poi1 (enve bar);
mesh = bar et barsur;
tass mesh;
sauv form mesh;
trac qual cach mesh;
fin;
```

fet404.epx

```
FET404
ECHO
!CONV win
CAST mesh
EULE TRID
DIME
  ADAP NPOI 31836 TETR 172800 ENDA
TERM
GEOM TETR bar TERM
COMP GROU 4 'bar1' LECT bar TERM COND XB LT 0.5
            'bar2' LECT bar DIFF bar1 TERM
            'ea' LECT bar TERM COND NEAR POIN 0.25 0 0
            'eb' LECT bar TERM COND NEAR POIN 0.75 0 0
     NGRO 5 'xaxo' LECT bar TERM COND LINE X1 0 Y1 0 Z1 0
                                           X2 1 Y2 0 Z2 0 TOL 1.E-4
            'bas1' LECT bar TERM COND X LT 0.0001
            'bas2' LECT bar TERM COND X GT 0.9999
            'na'   LECT bar TERM COND NEAR POIN 0.25 0 0
            'nb'   LECT bar TERM COND NEAR POIN 0.75 0 0
     COUL ROUG LECT bar1 TERM
          VERT LECT bar2 TERM
MATE GAZP RO 10 GAMM 1.5 PINI 1.E6 PREF 1.E5
          LECT bar1 TERM
     GAZP RO  1 GAMM 1.5 PINI 1.E5 PREF 1.E5
          LECT bar2 _tetr TERM
INIT ADAP SPLI LEVE 3 LECT bar TERM
LINK COUP BLOQ 1 LECT bas1 bas2 TERM
          BLOQ 23 LECT barsur TERM
ECRI COOR DEPL VITE ACCE FINT FEXT CONT ECRO TFRE 0.3E-3
     FICH ALIC TEMP FREQ 1
          POIN LECT na nb TERM
          ELEM LECT ea eb TERM
     FICH ALIC TFRE 1.0E-5
OPTI NOTE STEP IO
 AMOR QUAD 4.0 LINE 0.2
 CSTA 0.5
 LOG 1
CALC TINI 0. TEND 0.60E-3
*=============================================================
SUIT
Post-treatment (space curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 1
SCOU 62 'ro_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 2
SCOU 65 'vx_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                    TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                    TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                    TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR VERT
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR VERT
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR VERT
LIST 65 AXES 1.0 'VELOC. [M/S]'
*
QUAL ECRO COMP 1 LECT ea   TERM REFE  9.99349E+5 TOLE 2.E-2
     ECRO COMP 1 LECT eb   TERM REFE  2.81990E+5 TOLE 2.E-2
     ECRO COMP 2 LECT ea   TERM REFE  9.99566E+0 TOLE 2.E-2
     ECRO COMP 2 LECT eb   TERM REFE  1.90769E+0 TOLE 2.E-2
*=============================================================
SUIT
Post-treatment (time curves from alice temps file)
ECHO
RESU ALIC TEMP GARD PSCR
SORT GRAP
PERF 'fet404t.pun'
AXTE 1.0 'Time [s]'
COUR 1 'p_ea'  ECRO COMP 1 ELEM LECT ea TERM
COUR 2 'ro_ea' ECRO COMP 2 ELEM LECT ea TERM
COUR 3 'vx_ea' VITE COMP 1 NOEU LECT na TERM
COUR 4 'p_eb'  ECRO COMP 1 ELEM LECT eb TERM
COUR 5 'ro_eb' ECRO COMP 2 ELEM LECT eb TERM
COUR 6 'vx_eb' VITE COMP 1 NOEU LECT nb TERM
TRAC 1 4 AXES 1.0 'PRESS. [PA]'
COLO NOIR NOIR
TRAC 2 5 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR NOIR
TRAC 3 6 AXES 1.0 'VELOC. [M/S]'
COLO NOIR NOIR
LIST 1 4 AXES 1.0 'PRESS. [PA]'
LIST 2 5 AXES 1.0 'DENS. [KG/M3]'
LIST 3 6 AXES 1.0 'VELOC. [M/S]'
*=============================================================
SUIT
Post treatment (BMPs from alice file)
ECHO
RESU ALIC GARD PSCR
OPTI PRIN
SORT VISU NSTO 61
PLAY
CAME   1 EYE   5.00000E-01  5.00000E-03  3.00015E-01
!        Q     1.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
         VIEW  0.00000E+00  0.00000E+00 -1.00000E+00
         RIGH  1.00000E+00  0.00000E+00  0.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   5.25000E+01
```

```
SCEN GEOM NAVI FREE
!        LINE HEOU
     ISO  FILL FIEL VITE SCAL USER PROG 20 PAS 20 280 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
SCEN GEOM NAVI FREE
!        LINE HEOU
     ISO  FILL FIEL ECRO 2 SCAL USER PROG 1 PAS 0.6 8.8 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
ENDPLAY
*=================================================================
FIN
```

fet404a.epx

```
FET404A
ECHO
RESU ALIC 'fet404.ali' GARD PSCR
COMP NGRO 4 'xaxo' LECT bar TERM COND LINE X1 0 Y1   0 Z1   0
                                           X2 1 Y2   0 Z2   0 TOL 1.E-4
            'xaxp' LECT bar TERM COND LINE X1 0 Y1 .01 Z1   0
                                           X2 1 Y2 .01 Z2   0 TOL 1.E-4
            'xaxq' LECT bar TERM COND LINE X1 0 Y1 .01 Z1 .01
                                           X2 1 Y2 .01 Z2 .01 TOL 1.E-4
            'xaxr' LECT bar TERM COND LINE X1 0 Y1   0 Z1 .01
                                           X2 1 Y2   0 Z2 .01 TOL 1.E-4
SORT VISU NSTO 61
FIN
```

fet404b.epx

```
FET404B
ECHO
OPTI PRIN
RESU ALIC 'fet404.ali' GARD PSCR
COMP NGRO 4 'xaxo' LECT bar TERM COND LINE X1 0 Y1   0 Z1   0
                                           X2 1 Y2   0 Z2   0 TOL 1.E-4
            'xaxp' LECT bar TERM COND LINE X1 0 Y1 .01 Z1   0
                                           X2 1 Y2 .01 Z2   0 TOL 1.E-4
            'xaxq' LECT bar TERM COND LINE X1 0 Y1 .01 Z1 .01
                                           X2 1 Y2 .01 Z2 .01 TOL 1.E-4
            'xaxr' LECT bar TERM COND LINE X1 0 Y1   0 Z1 .01
                                           X2 1 Y2   0 Z2 .01 TOL 1.E-4
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61o'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 1
SCOU 62 'ro_61o' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 2
SCOU 65 'vx_61o' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         VITE COMP 1
SCOU 161 'p_61p'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 1
SCOU 162 'ro_61p' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 2
SCOU 165 'vx_61p' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         VITE COMP 1
SCOU 261 'p_61q'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 1
SCOU 262 'ro_61q' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 2
SCOU 265 'vx_61q' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         VITE COMP 1
SCOU 361 'p_61r'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 1
SCOU 362 'ro_61r' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 2
SCOU 365 'vx_61r' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                 TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                 TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                 TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR BLEU TURQ VERT ROUG
LIST 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
TRAC 62 162 262 362 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR BLEU TURQ VERT ROUG
TRAC 65 165 265 365 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR BLEU TURQ VERT ROUG
FIN
```

fet404c.epx

```
FET404C
ECHO
OPTI PRIN
RESU ALIC 'fet404.ali' GARD PSCR
COMP NGRO 4 'xaxo' LECT bar TERM COND LINE X1 0 Y1   0 Z1   0
                                           X2 1 Y2   0 Z2   0 TOL 1.E-4
            'xaxp' LECT bar TERM COND LINE X1 0 Y1 .01 Z1   0
                                           X2 1 Y2 .01 Z2   0 TOL 1.E-4
            'xaxq' LECT bar TERM COND LINE X1 0 Y1 .01 Z1 .01
                                           X2 1 Y2 .01 Z2 .01 TOL 1.E-4
            'xaxr' LECT bar TERM COND LINE X1 0 Y1   0 Z1 .01
                                           X2 1 Y2   0 Z2 .01 TOL 1.E-4
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61o'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 1
SCOU 62 'ro_61o' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 2
SCOU 65 'vx_61o' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         VITE COMP 1
SCOU 161 'p_61p'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 1
SCOU 162 'ro_61p' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 2
SCOU 165 'vx_61p' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         VITE COMP 1
SCOU 261 'p_61q'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 1
SCOU 262 'ro_61q' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 2
SCOU 265 'vx_61q' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         VITE COMP 1
SCOU 361 'p_61r'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 1
SCOU 362 'ro_61r' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 2
SCOU 365 'vx_61r' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                 TIME 0.0E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                 TIME 0.0E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                 TIME 0.0E-3 NRAR 30 VARI 5
TRAC 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR BLEU TURQ VERT ROUG
LIST 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
TRAC 62 162 262 362 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR BLEU TURQ VERT ROUG
TRAC 65 165 265 365 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR BLEU TURQ VERT ROUG
TRAC 161 71 AXES 1.0 'PRESS. [PA]'
COLO BLEU ROUG
TRAC 162 72 AXES 1.0 'DENS. [KG/M3]'
COLO BLEU ROUG
TRAC 165 75 AXES 1.0 'VELOC. [M/S]'
COLO BLEU ROUG
TRAC 161 AXES 1.0 'PRESS. [PA]'
COLO BLEU
TRAC 162 AXES 1.0 'DENS. [KG/M3]'
COLO BLEU
TRAC 165 AXES 1.0 'VELOC. [M/S]'
COLO BLEU
FIN
```

fet405.dgibi

```
opti echo 1;
opti donn 'pxhex2t2.proc';
opti dime 3 elem cub8;
opti titr 'FET405';
opti sauv form 'fet405.msh';
opti trac psc ftra 'fet405_mesh.ps';
p0 = 0 0 0;
dd = 0.01;
n = 100;
tol = 0.0001;
p1 = 0 dd 0;
p2 = 0 dd dd;
p3 =  0 0 dd;
c1 = p0 d 1 p1;
c2 = p1 d 1 p2;
c3 = p2 d 1 p3;
c4 = p3 d 1 p0;
base = dall c1 c2 c3 c4 plan;
bar8 = base volu n tran ((n*dd) 0 0);
i = 0;
repe loop1 (nbel bar8);
  i = i + 1;
  cubei = bar8 elem i;
  tt = pxhex2t2 cubei;
  si (ega i 1);
    bar = tt;
  sinon;
    bar = bar et tt;
  finsi;
fin loop1;
elim tol bar;
barsur = chan poi1 (enve bar);
mesh = bar et barsur;
tass mesh;
sauv form mesh;
trac qual cach mesh;
fin;
```

fet405.epx

```
FET405
ECHO
!CONV win
CAST mesh
EULE TRID
DIME
  ADAP NPOI 8182 TETR 42688 ENDA
TERM
GEOM TETR bar TERM
COMP GROU 4 'bar1' LECT bar TERM COND XB LT 0.5
            'bar2' LECT bar DIFF bar1 TERM
            'ea' LECT bar TERM COND NEAR POIN 0.25 0 0
            'eb' LECT bar TERM COND NEAR POIN 0.75 0 0
     NGRO 5 'xaxo' LECT bar TERM COND LINE X1 0 Y1 0 Z1 0
                                           X2 1 Y2 0 Z2 0 TOL 1.E-4
            'bas1' LECT bar TERM COND X LT 0.0001
            'bas2' LECT bar TERM COND X GT 0.9999
            'na'   LECT bar TERM COND NEAR POIN 0.25 0 0
            'nb'   LECT bar TERM COND NEAR POIN 0.75 0 0
     COUL ROUG LECT bar1 TERM
          VERT LECT bar2 TERM
WAVE 4 PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 613.568783589856 ! shock wave
            MAXL 3 H1 0.045 H2 0.15
       PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 295.278289836459 ! c.d. wave
            MAXL 3 H1 0.045 H2 0.15
       PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 18.2004723251679 ! r.wave (ri.)
```

```
          MAXL 3 H1 0.045 H2 0.05
       PLAN X 0.5 Y 0 Z 0 NX -1 NY 0 NZ 0 T0 0 C 387.298334620742 ! r. wav (le.)
          MAXL 3 H1 0.045 H2 0.15
MATE GAZP RO 10 GAMM 1.5 PINI 1.E6 PREF 1.E5
         LECT bar1 TERM
     GAZP RO  1 GAMM 1.5 PINI 1.E5 PREF 1.E5
         LECT bar2 _tetr TERM
LINK COUP BLOQ 1 LECT bas1 bas2 TERM
         BLOQ 23 LECT barsur TERM
ECRI COOR DEPL VITE ACCE FINT FEXT CONT ECRO TFRE 0.3E-3
     FICH ALIC TEMP FREQ 1
         POIN LECT na nb TERM
         ELEM LECT ea eb TERM
     FICH ALIC TFRE 1.0E-5
OPTI NOTE STEP IO
 AMOR QUAD 4.0 LINE 0.2
 CSTA 0.125
 LOG 1
CALC TINI 0. TEND 0.60E-3
*=================================================================
SUIT
Post-treatment (space curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 1
SCOU 62 'ro_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 2
SCOU 65 'vx_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR VERT
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR VERT
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR VERT
LIST 65 AXES 1.0 'VELOC. [M/S]'
*
QUAL ECRO COMP 1 LECT ea   TERM REFE  9.99360E+5 TOLE 2.E-2
     ECRO COMP 1 LECT eb   TERM REFE  2.83005E+5 TOLE 2.E-2
     ECRO COMP 2 LECT ea   TERM REFE  9.99574E+0 TOLE 2.E-2
     ECRO COMP 2 LECT eb   TERM REFE  1.93073E+0 TOLE 2.E-2
*=================================================================
SUIT
Post-treatment (time curves from alice temps file)
ECHO
RESU ALIC TEMP GARD PSCR
SORT GRAP
PERF 'fet405t.pun'
AXTE 1.0 'Time [s]'
COUR 1 'p_ea'  ECRO COMP 1 ELEM LECT ea TERM
COUR 2 'ro_ea' ECRO COMP 2 ELEM LECT ea TERM
COUR 3 'vx_ea' VITE COMP 1 NOEU LECT na TERM
COUR 4 'p_eb'  ECRO COMP 1 ELEM LECT eb TERM
COUR 5 'ro_eb' ECRO COMP 2 ELEM LECT eb TERM
COUR 6 'vx_eb' VITE COMP 1 NOEU LECT nb TERM
TRAC 1 4 AXES 1.0 'PRESS. [PA]'
COLO NOIR NOIR
TRAC 2 5 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR NOIR
TRAC 3 6 AXES 1.0 'VELOC. [M/S]'
COLO NOIR NOIR
LIST 1 4 AXES 1.0 'PRESS. [PA]'
LIST 2 5 AXES 1.0 'DENS. [KG/M3]'
LIST 3 6 AXES 1.0 'VELOC. [M/S]'
*=================================================================
SUIT
Post treatment (BMPs from alice file)
ECHO
RESU ALIC GARD PSCR
OPTI PRIN
SORT VISU NSTO 61
PLAY
CAME   1 EYE   5.00000E-01  5.00000E-03  3.00015E-01
!        Q     1.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
         VIEW  0.00000E+00  0.00000E+00 -1.00000E+00
         RIGH  1.00000E+00  0.00000E+00  0.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   5.25000E+01
SCEN GEOM NAVI FREE
!        LINE HEOU
     ISO  FILL FIEL VITE SCAL USER PROG 20 PAS 20 280 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
SCEN GEOM NAVI FREE
!        LINE HEOU
     ISO  FILL FIEL ECRO 2 SCAL USER PROG 1 PAS 0.6 8.8 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
ENDPLAY
*=================================================================
FIN
```

fet405a.epx

```
FET405A
ECHO
RESU ALIC 'fet405.ali' GARD PSCR
COMP NGRO 4 'xaxo' LECT bar TERM COND LINE X1 0 Y1   0 Z1   0
                                           X2 1 Y2   0 Z2   0 TOL 1.E-4
            'xaxp' LECT bar TERM COND LINE X1 0 Y1 .01 Z1   0
                                           X2 1 Y2 .01 Z2   0 TOL 1.E-4
            'xaxq' LECT bar TERM COND LINE X1 0 Y1 .01 Z1 .01
                                           X2 1 Y2 .01 Z2 .01 TOL 1.E-4
            'xaxr' LECT bar TERM COND LINE X1 0 Y1   0 Z1 .01
                                           X2 1 Y2   0 Z2 .01 TOL 1.E-4
SORT VISU NSTO 61
FIN
```

fet405b.epx

```
FET405B
ECHO
OPTI PRIN
RESU ALIC 'fet405.ali' GARD PSCR
COMP NGRO 4 'xaxo' LECT bar TERM COND LINE X1 0 Y1   0 Z1   0
                                           X2 1 Y2   0 Z2   0 TOL 1.E-4
            'xaxp' LECT bar TERM COND LINE X1 0 Y1 .01 Z1   0
                                           X2 1 Y2 .01 Z2   0 TOL 1.E-4
            'xaxq' LECT bar TERM COND LINE X1 0 Y1 .01 Z1 .01
                                           X2 1 Y2 .01 Z2 .01 TOL 1.E-4
            'xaxr' LECT bar TERM COND LINE X1 0 Y1   0 Z1 .01
                                           X2 1 Y2   0 Z2 .01 TOL 1.E-4
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61o'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 1
SCOU 62 'ro_61o' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 2
SCOU 65 'vx_61o' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         VITE COMP 1
SCOU 161 'p_61p'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 1
SCOU 162 'ro_61p' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 2
SCOU 165 'vx_61p' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         VITE COMP 1
SCOU 261 'p_61q'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 1
SCOU 262 'ro_61q' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 2
SCOU 265 'vx_61q' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         VITE COMP 1
SCOU 361 'p_61r'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 1
SCOU 362 'ro_61r' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 2
SCOU 365 'vx_61r' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR BLEU TURQ VERT ROUG
LIST 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
TRAC 62 162 262 362 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR BLEU TURQ VERT ROUG
TRAC 65 165 265 365 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR BLEU TURQ VERT ROUG
FIN
```

fet405c.epx

```
FET405C
ECHO
OPTI PRIN
RESU ALIC 'fet405.ali' GARD PSCR
COMP NGRO 4 'xaxo' LECT bar TERM COND LINE X1 0 Y1   0 Z1   0
                                           X2 1 Y2   0 Z2   0 TOL 1.E-4
            'xaxp' LECT bar TERM COND LINE X1 0 Y1 .01 Z1   0
                                           X2 1 Y2 .01 Z2   0 TOL 1.E-4
            'xaxq' LECT bar TERM COND LINE X1 0 Y1 .01 Z1 .01
                                           X2 1 Y2 .01 Z2 .01 TOL 1.E-4
            'xaxr' LECT bar TERM COND LINE X1 0 Y1   0 Z1 .01
                                           X2 1 Y2   0 Z2 .01 TOL 1.E-4
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61o'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 1
SCOU 62 'ro_61o' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         ECRO COMP 2
SCOU 65 'vx_61o' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                         VITE COMP 1
SCOU 161 'p_61p'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 1
SCOU 162 'ro_61p' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         ECRO COMP 2
SCOU 165 'vx_61p' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxp TERM
                         VITE COMP 1
SCOU 261 'p_61q'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 1
SCOU 262 'ro_61q' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         ECRO COMP 2
SCOU 265 'vx_61q' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxq TERM
                         VITE COMP 1
SCOU 361 'p_61r'  NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 1
SCOU 362 'ro_61r' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         ECRO COMP 2
SCOU 365 'vx_61r' NSTO 1 SAXE 1.0 'curr_abscissa' LECT xaxr TERM
                         VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.0E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.0E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.0E-3 NRAR 30 VARI 5
TRAC 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR BLEU TURQ VERT ROUG
LIST 61 161 261 361 71 AXES 1.0 'PRESS. [PA]'
TRAC 62 162 262 362 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR BLEU TURQ VERT ROUG
```

```
TRAC 65 165 265 365 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR BLEU TURQ VERT ROUG
TRAC 161 71 AXES 1.0 'PRESS. [PA]'
COLO BLEU ROUG
TRAC 162 72 AXES 1.0 'DENS. [KG/M3]'
COLO BLEU ROUG
TRAC 165 75 AXES 1.0 'VELOC. [M/S]'
COLO BLEU ROUG
TRAC 161 AXES 1.0 'PRESS. [PA]'
COLO BLEU
TRAC 162 AXES 1.0 'DENS. [KG/M3]'
COLO BLEU
TRAC 165 AXES 1.0 'VELOC. [M/S]'
COLO BLEU
FIN
```

fet406.epx

```
FET406
ECHO
!CONV win
CAST mesh
EULE TRID
DIME
  ADAP NPOI 259 TETR 1008 ENDA
TERM
GEOM TETR bar TERM
COMP GROU 4 'bar1' LECT bar TERM COND XB LT 0.5
            'bar2' LECT bar DIFF bar1 TERM
            'ea' LECT bar TERM COND NEAR POIN 0.25 0 0
            'eb' LECT bar TERM COND NEAR POIN 0.75 0 0
     NGRO 5 'xaxo' LECT bar TERM COND LINE X1 0 Y1 0 Z1 0
                                           X2 1 Y2 0 Z2 0 TOL 1.E-4
            'bas1' LECT bar TERM COND X LT 0.0001
            'bas2' LECT bar TERM COND X GT 0.9999
            'na'   LECT bar TERM COND NEAR POIN 0.25 0 0
            'nb'   LECT bar TERM COND NEAR POIN 0.75 0 0
     COUL ROUG LECT bar1 TERM
          VERT LECT bar2 TERM
WAVE 4 PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 613.568783589856 ! shock wave
            MAXL 2 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 295.278289836459 ! c.d. wave
            MAXL 2 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 Z 0 NX 1 NY 0 NZ 0 T0 0 C 18.2004723251679 ! r.wave (ri.)
            MAXL 2 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 Z 0 NX -1 NY 0 NZ 0 T0 0 C 387.298334620742 ! r. wav (le.)
            MAXL 2 H1 0.015 H2 0.05
MATE GAZP RO 10 GAMM 1.5 PINI 1.E6 PREF 1.E5
          LECT bar1 TERM
     GAZP RO  1 GAMM 1.5 PINI 1.E5 PREF 1.E5
          LECT bar2 _tetr TERM
LINK COUP BLOQ 1 LECT bas1 bas2 TERM
          BLOQ 23 LECT barsur TERM
ECRI COOR DEPL VITE ACCE FINT FEXT CONT ECRO TFRE 0.3E-3
     FICH ALIC TEMP FREQ 1
          POIN LECT na nb TERM
          ELEM LECT ea eb TERM
     FICH ALIC TFRE 1.0E-5
OPTI NOTE STEP IO
 AMOR QUAD 4.0 LINE 0.2
 CSTA 0.125
 LOG 1
CALC TINI 0. TEND 0.60E-3
*=================================================================
SUIT
Post-treatment (space curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
AXTE 1.0 'Time [s]'
SCOU 61 'p_61'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 1
SCOU 62 'ro_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 2
SCOU 65 'vx_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR VERT
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR VERT
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR VERT
LIST 65 AXES 1.0 'VELOC. [M/S]'
*
QUAL ECRO COMP 1 LECT ea   TERM REFE  9.97505E+5 TOLE 2.E-2
     ECRO COMP 1 LECT eb   TERM REFE  2.84640E+5 TOLE 2.E-2
     ECRO COMP 2 LECT ea   TERM REFE  9.98336E+0 TOLE 2.E-2
     ECRO COMP 2 LECT eb   TERM REFE  1.93773E+0 TOLE 2.E-2
*=================================================================
SUIT
Post-treatment (time curves from alice temps file)
ECHO
RESU ALIC TEMP GARD PSCR
SORT GRAP
PERF 'fet406t.pun'
AXTE 1.0 'Time [s]'
COUR 1 'p_ea'  ECRO COMP 1 ELEM LECT ea TERM
COUR 2 'ro_ea' ECRO COMP 2 ELEM LECT ea TERM
COUR 3 'vx_ea' VITE COMP 1 NOEU LECT na TERM
COUR 4 'p_eb'  ECRO COMP 1 ELEM LECT eb TERM
COUR 5 'ro_eb' ECRO COMP 2 ELEM LECT eb TERM
COUR 6 'vx_eb' VITE COMP 1 NOEU LECT nb TERM
TRAC 1 4 AXES 1.0 'PRESS. [PA]'
COLO NOIR NOIR
TRAC 2 5 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR NOIR
TRAC 3 6 AXES 1.0 'VELOC. [M/S]'
COLO NOIR NOIR
LIST 1 4 AXES 1.0 'PRESS. [PA]'
LIST 2 5 AXES 1.0 'DENS. [KG/M3]'
LIST 3 6 AXES 1.0 'VELOC. [M/S]'
*=================================================================
SUIT
Post treatment (BMPs from alice file)
ECHO
RESU ALIC GARD PSCR
OPTI PRIN
SORT VISU NSTO 61
PLAY
CAME   1 EYE   5.00000E-01  5.00000E-03  3.00015E-01
!        Q     1.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
         VIEW  0.00000E+00  0.00000E+00 -1.00000E+00
         RIGH  1.00000E+00  0.00000E+00  0.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   5.25000E+01
SCEN GEOM NAVI FREE
!        LINE HEOU
     ISO  FILL FIEL VITE SCAL USER PROG 20 PAS 20 280 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
SCEN GEOM NAVI FREE
!        LINE HEOU
     ISO  FILL FIEL ECRO 2 SCAL USER PROG 1 PAS 0.6 8.8 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
ENDPLAY
*=================================================================
FIN
```

fetr00.dgibi

```
opti echo 0;
opti donn 'pxordpoi.proc';
opti echo 1;
opti dime 2 elem qua4;
opti sauv form 'fetr00.msh';
opti trac psc ftra 'fetr00_mesh.ps';
p0 = 0 0;
p0p = p0 plus (0 0.00125);
pmid = 0.5 0;
p1 = 1 0;
p1p = p1 plus (0 0.00125);
pa = 0.25 0;
pb = 0.75 0;
tol = 1.E-5;
n = 800;
n2 = n / 2;
n4 = n2 / 2;
c11 = p0 d n4 pa;
c12 = pa d n4 pmid;
c1 = c11 et c12;
c21 = pmid d n4 pb;
c22 = pb d n4 p1;
c2 = c21 et c22;
bar11 = c11 tran 1 (0 0.00125);
bar12 = c12 tran 1 (0 0.00125);
bar1q = bar11 et bar12;
bar1 = chan tri3 bar1q;
bar21 = c21 tran 1 (0 0.00125);
bar22 = c22 tran 1 (0 0.00125);
bar2q = bar21 et bar22;
bar2 = chan tri3 bar2q;
bar = bar1 et bar2;
elim tol (bar et p0p et p1p et pa et pb);
ea = bar1 elem cont pa;
eb = bar2 elem cont pb;
xax = chan 'POI1' (c1 et c2);
xaxo = pxordpoi xax p0;
mesh = bar et ea et eb et xaxo;
tass mesh;
sauv form mesh;
trac qual mesh;
trac ((cont mesh) et ea et eb);
fin;
```

fetr00.epx

```
FETR00 (with mesh reduced to 800 x 1 x 2 to save CPU time)
ECHO
!CONV win
CAST mesh
EULE DPLA
GEOM TRIA bar TERM
MATE GAZP RO 10 GAMM 1.5 PINI 1.E6 PREF 1.E5
          LECT bar1 TERM
     GAZP RO  1 GAMM 1.5 PINI 1.E5 PREF 1.E5
          LECT bar2 TERM
LINK COUP BLOQ 1 LECT p0 p0p p1 p1p TERM
          BLOQ 2 LECT bar TERM
ECRI COOR DEPL VITE ACCE FINT FEXT CONT ECRO TFRE 0.3E-3
     FICH ALIC TEMP FREQ 1
          POIN LECT pa pmid pb TERM
          ELEM LECT ea eb TERM
     FICH ALIC TFRE 1.0E-5
OPTI NOTE STEP IO
 AMOR QUAD 4.0 LINE 0.2
 csta 0.5
 log 1
CALC TINI 0. TEND 0.60E-3
*=================================================================
SUIT
Post-treatment (space curves from alice file)
ECHO
RESU ALIC GARD PSCR
SORT GRAP
!PERF 'fetr00.pun'
AXTE 1.0 'Time [s]'
```

```
SCOU 61 'p_61'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 1
SCOU 62 'ro_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        ECRO COMP 2
SCOU 65 'vx_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR ROUG
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR ROUG
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR ROUG
LIST 65 AXES 1.0 'VELOC. [M/S]'
*
QUAL ECRO COMP 1 LECT ea   TERM REFE  9.99990E+5 TOLE 2.E-2
     ECRO COMP 1 LECT eb   TERM REFE  2.82558E+5 TOLE 2.E-2
     ECRO COMP 2 LECT ea   TERM REFE  9.99993E+0 TOLE 2.E-2
     ECRO COMP 2 LECT eb   TERM REFE  1.91214E+0 TOLE 2.E-2
*===============================================================
SUIT
Post treatment (BMPs from alice file)
ECHO
RESU ALIC GARD PSCR
OPTI PRIN
SORT VISU NSTO 61
PLAY
CAME   1 EYE   5.00000E-01  5.00000E-03  3.00015E-01
!        Q     1.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
         VIEW  0.00000E+00  0.00000E+00 -1.00000E+00
         RIGH  1.00000E+00  0.00000E+00  0.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   5.25000E+01
SCEN GEOM NAVI FREE
          LINE HEOU
     ISO  FILL FIEL VITE SCAL USER PROG 20 PAS 20 280 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
SCEN GEOM NAVI FREE
          LINE HEOU
     ISO  FILL FIEL ECRO 2 SCAL USER PROG 1 PAS 0.6 8.8 TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP REND
ENDPLAY
*===============================================================
FIN
```

fetr01.epx

```
FETR01
ECHO
!CONV win
EULE DPLA
DIME
  ADAP NPOI 676 TRIA 1528 ENDA
TERM
GEOM LIBR POIN 206 CAR1 1 TRIA 200 TERM
 0.00 0.00  0.01 0.00  0.02 0.00  0.03 0.00  0.04 0.00  0.05 0.00
            0.06 0.00  0.07 0.00  0.08 0.00  0.09 0.00  0.10 0.00
            0.11 0.00  0.12 0.00  0.13 0.00  0.14 0.00  0.15 0.00
            0.16 0.00  0.17 0.00  0.18 0.00  0.19 0.00  0.20 0.00
            0.21 0.00  0.22 0.00  0.23 0.00  0.24 0.00  0.25 0.00
            0.26 0.00  0.27 0.00  0.28 0.00  0.29 0.00  0.30 0.00
            0.31 0.00  0.32 0.00  0.33 0.00  0.34 0.00  0.35 0.00
            0.36 0.00  0.37 0.00  0.38 0.00  0.39 0.00  0.40 0.00
            0.41 0.00  0.42 0.00  0.43 0.00  0.44 0.00  0.45 0.00
            0.46 0.00  0.47 0.00  0.48 0.00  0.49 0.00  0.50 0.00
            0.51 0.00  0.52 0.00  0.53 0.00  0.54 0.00  0.55 0.00
            0.56 0.00  0.57 0.00  0.58 0.00  0.59 0.00  0.60 0.00
            0.61 0.00  0.62 0.00  0.63 0.00  0.64 0.00  0.65 0.00
            0.66 0.00  0.67 0.00  0.68 0.00  0.69 0.00  0.70 0.00
            0.71 0.00  0.72 0.00  0.73 0.00  0.74 0.00  0.75 0.00
            0.76 0.00  0.77 0.00  0.78 0.00  0.79 0.00  0.80 0.00
            0.81 0.00  0.82 0.00  0.83 0.00  0.84 0.00  0.85 0.00
            0.86 0.00  0.87 0.00  0.88 0.00  0.89 0.00  0.90 0.00
            0.91 0.00  0.92 0.00  0.93 0.00  0.94 0.00  0.95 0.00
            0.96 0.00  0.97 0.00  0.98 0.00  0.99 0.00  1.00 0.00
 0.00 0.01  0.01 0.01  0.02 0.01  0.03 0.01  0.04 0.01  0.05 0.01
            0.06 0.01  0.07 0.01  0.08 0.01  0.09 0.01  0.10 0.01
            0.11 0.01  0.12 0.01  0.13 0.01  0.14 0.01  0.15 0.01
            0.16 0.01  0.17 0.01  0.18 0.01  0.19 0.01  0.20 0.01
            0.21 0.01  0.22 0.01  0.23 0.01  0.24 0.01  0.25 0.01
            0.26 0.01  0.27 0.01  0.28 0.01  0.29 0.01  0.30 0.01
            0.31 0.01  0.32 0.01  0.33 0.01  0.34 0.01  0.35 0.01
            0.36 0.01  0.37 0.01  0.38 0.01  0.39 0.01  0.40 0.01
            0.41 0.01  0.42 0.01  0.43 0.01  0.44 0.01  0.45 0.01
            0.46 0.01  0.47 0.01  0.48 0.01  0.49 0.01  0.50 0.01
            0.51 0.01  0.52 0.01  0.53 0.01  0.54 0.01  0.55 0.01
            0.56 0.01  0.57 0.01  0.58 0.01  0.59 0.01  0.60 0.01
            0.61 0.01  0.62 0.01  0.63 0.01  0.64 0.01  0.65 0.01
            0.66 0.01  0.67 0.01  0.68 0.01  0.69 0.01  0.70 0.01
            0.71 0.01  0.72 0.01  0.73 0.01  0.74 0.01  0.75 0.01
            0.76 0.01  0.77 0.01  0.78 0.01  0.79 0.01  0.80 0.01
            0.81 0.01  0.82 0.01  0.83 0.01  0.84 0.01  0.85 0.01
            0.86 0.01  0.87 0.01  0.88 0.01  0.89 0.01  0.90 0.01
            0.91 0.01  0.92 0.01  0.93 0.01  0.94 0.01  0.95 0.01
            0.96 0.01  0.97 0.01  0.98 0.01  0.99 0.01  1.00 0.01
 0 0  1 0  1 1  0 1      ! bidon nodes (203 a 206)
 203 204 205 206         ! bidon element (1)
   1   2 103
 103 102   1
   2   3 103
 104 103   3
   3   4 105
 105 104   3
   4   5 105
 106 105   5
   5   6 107
 107 106   5
   6   7 107
 108 107   7
   7   8 109
 109 108   7
   8   9 109
 110 109   9
   9  10 111
 111 110   9
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  99 100 201
 201 200  99
 100 101 201
 202 201 101
COMP GROU 6 'bar1' LECT   2 PAS 1 101 TERM
            'bar2' LECT 102 PAS 1 201 TERM
            'bar'  LECT bar1 bar2 TERM
            'ea'   LECT  51 TERM
            'eb'   LECT 151 TERM
            'bidon' LECT 1 TERM
     NGRO 7 'p0'   LECT   1 TERM
            'p0p'  LECT 102 TERM
            'p1'   LECT 101 TERM
            'p1p'  LECT 202 TERM
            'pa'   LECT  26 TERM
            'pmid' LECT  51 TERM
            'pb'   LECT  76 TERM
WAVE 4 PLAN X 0.5 Y 0 NX 1 NY 0 T0 0 C 613.568783589856 ! shock wave
            MAXL 4 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 NX 1 NY 0 T0 0 C 295.278289836459 ! c.d. wave
            MAXL 4 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 NX 1 NY 0 T0 0 C 18.2004723251679 ! r.wave (right)
            MAXL 4 H1 0.015 H2 0.05
       PLAN X 0.5 Y 0 NX -1 NY 0 T0 0 C 387.298334620742 ! r. wave (left)
            MAXL 4 H1 0.015 H2 0.05
MATE GAZP RO 10 GAMM 1.5 PINI 1.E6 PREF 1.E5
          LECT bar1 TERM
     GAZP RO  1 GAMM 1.5 PINI 1.E5 PREF 1.E5
          LECT bar2 _tria TERM
*
**** Material with no elements, then isolated from the rest.
*    In this way it is taken into account in the dimension of ECRO
*    in the extension region. One can check that this material
*    does not affect the final result.
*
     CREB
        PINI 1.2  PREF 1.2  TINI  1.090909090909
        KSI0 0.0 ! Unburnt region.
        K0 0.0
*
        TMAX 6000.
        R    1.0
        NESP 2
        ORDP 0
        NLHS 1
*
         COMP1
         MMOL 1.0 H0 -4.2  CREA 1.
         CV0  2.5
         YMAS 0.7 ! Mass fraction if the unburnt region
*
         COMP2
         MMOL 1.0 H0 -4.2  CREA -1.
         CV0  2.5
         YMAS 0.3 ! Mass fraction if the unburnt region
*
         LECT NONE TERM
*
     FANT 1.0 LECT bidon TERM
LINK COUP BLOQ 1 LECT p0 p0p p1 p1p TERM
          BLOQ 2 LECT bar TERM
ECRI COOR DEPL VITE ACCE FINT FEXT CONT ECRO TFRE 0.3E-3
     FICH ALIC TEMP FREQ 1
          POIN LECT pa pmid pb TERM
          ELEM LECT ea eb TERM
     FICH ALIC TFRE 1.0E-5
OPTI NOTE STEP IO
 AMOR QUAD 4.0 LINE 0.2
 csta 0.25
 log 1
CALC TINI 0. TEND 0.60E-3
*===============================================================
SUIT
Post-treatment (space curves from alice file)
ECHO
RESU ALIC GARD PSCR
COMP NGRO 1 'xaxo' LECT 1 PAS 1 101 TERM
SORT GRAP
!PERF 'fetr01.pun'
AXTE 1.0 'Time [s]'
*
* Attention: le SUPP /LECT/ est **mandatoire** dans les directives ci-dessous
* car sinon on risque de traiter les noeuds de l'element "bidon" comme
* faisant partie de l'abscisse curviligne (qui doit etre basee seulement
* sur les TRIA)
* En general, il est toujours une bonne idee de specifier le SUPPort,
* s'il y a des doutes ...
*
SCOU 61 'p_61'  NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        SUPP LECT bar TERM
                        ECRO COMP 1
SCOU 62 'ro_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        SUPP LECT bar TERM
                        ECRO COMP 2
SCOU 65 'vx_61' NSTO 61 SAXE 1.0 'curr_abscissa' LECT xaxo TERM
                        SUPP LECT bar TERM
                        VITE COMP 1
DCOU 71 'p_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 1
DCOU 72 'r_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 2
DCOU 75 'v_ana' SHTU GAMM 1.5 ROM 10 ROP 1 EINT 2.0E5 LENM 0.5 LENP 0.5
                     TIME 0.60E-3 NRAR 30 VARI 5
TRAC 61 71 AXES 1.0 'PRESS. [PA]'
COLO NOIR ROUG
LIST 61 AXES 1.0 'PRESS. [PA]'
TRAC 62 72 AXES 1.0 'DENS. [KG/M3]'
COLO NOIR ROUG
LIST 62 AXES 1.0 'DENS. [KG/M3]'
TRAC 65 75 AXES 1.0 'VELOC. [M/S]'
COLO NOIR ROUG
LIST 65 AXES 1.0 'VELOC. [M/S]'
*
QUAL ECRO COMP 1 LECT ea   TERM REFE  9.99949E+5 TOLE 2.E-2
     ECRO COMP 1 LECT eb   TERM REFE  2.81068E+5 TOLE 2.E-2
     ECRO COMP 2 LECT ea   TERM REFE  9.99966E+0 TOLE 2.E-2
     ECRO COMP 2 LECT eb   TERM REFE  1.92601E+0 TOLE 2.E-2
*===============================================================
SUIT
Post treatment (BMPs from alice file)
ECHO
RESU ALIC GARD PSCR
OPTI PRIN
SORT VISU NSTO 61
PLAY
CAME   1 EYE   5.00000E-01  5.00000E-03  3.00015E-01
!        Q     1.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
         VIEW  0.00000E+00  0.00000E+00 -1.00000E+00
         RIGH  1.00000E+00  0.00000E+00  0.00000E+00
         UP    0.00000E+00  1.00000E+00  0.00000E+00
         FOV   5.25000E+01
SCEN GEOM NAVI FREE
          LINE HEOU
     ISO  FILL FIEL VITE SCAL USER PROG 20 PAS 20 280 TERM
               SUPP LECT bar TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP OBJE LECT bar TERM REND
SCEN GEOM NAVI FREE
          LINE HEOU
     ISO  FILL FIEL ECRO 2 SCAL USER PROG 1 PAS 0.6 8.8 TERM
               SUPP LECT bar TERM
     TEXT ISCA
     COLO PAPE
SLER CAM1 1 NFRA 1
TRAC OFFS SIZE 1400 400 FICH BMP OBJE LECT bar TERM REND
ENDPLAY
*===============================================================
FIN
```

pxhex2t2.proc

```
'DEBPROC' pxhex2t2 hexa*'MAILLAGE';
*
*-----------------------------------------------------
* Splits a hexahedron into 24 tetrahedra.
* First, the hexahedron is split into 6 pyramids,
* one for each face, by introducing an extra node
* at the centre of the hexahedron.
* Then, each pyramid is split into 4 tetrahedra,
* by adding an extra node at the centre of the
```

```
* corresponding face of the hexahedron.
* This produces twice as much tetrahedra as
* the procedure pxhex2te, and they are worse
* shaped (thinner), but the advantage
* is that the resulting mesh is symmetric.
*
* Input :
* -----
*     hexa : a mesh containing just one hexahedron
* Output :
* ------
*     tetr : mesh containing 24 tetrahedra
*--------------------------------------------------
*
hh = chan poi1 hexa;
*h = hh elem 1;
*
p1 = hh poin 1;
p2 = hh poin 2;
p3 = hh poin 3;
p4 = hh poin 4;
p5 = hh poin 5;
p6 = hh poin 6;
p7 = hh poin 7;
p8 = hh poin 8;
*
n1 = noeu p1;
n2 = noeu p2;
n3 = noeu p3;
n4 = noeu p4;
n5 = noeu p5;
n6 = noeu p6;
n7 = noeu p7;
n8 = noeu p8;
*
x1 y1 z1 = coor p1;
x2 y2 z2 = coor p2;
x3 y3 z3 = coor p3;
x4 y4 z4 = coor p4;
x5 y5 z5 = coor p5;
x6 y6 z6 = coor p6;
x7 y7 z7 = coor p7;
x8 y8 z8 = coor p8;
*
x9 = (x1 + x2 + x3 + x4 + x5 + x6 + x7 + x8) / 8.0;
y9 = (y1 + y2 + y3 + y4 + y5 + y6 + y7 + y8) / 8.0;
z9 = (z1 + z2 + z3 + z4 + z5 + z6 + z7 + z8) / 8.0;
*
p9 = x9 y9 z9;
*
* Pyramid # 1
*
x10 = (x1 + x2 + x3 + x4) / 4.0;
y10 = (y1 + y2 + y3 + y4) / 4.0;
z10 = (z1 + z2 + z3 + z4) / 4.0;
*
p10 = x10 y10 z10;
t1 = manu tet4 p1 p2 p10 p9;
t2 = manu tet4 p2 p3 p10 p9;
t3 = manu tet4 p3 p4 p10 p9;
t4 = manu tet4 p4 p1 p10 p9;
*
* Pyramid # 2
*
x11 = (x1 + x2 + x5 + x6) / 4.0;
y11 = (y1 + y2 + y5 + y6) / 4.0;
z11 = (z1 + z2 + z5 + z6) / 4.0;
*
p11 = x11 y11 z11;
t5 = manu tet4 p2 p1 p11 p9;
t6 = manu tet4 p6 p2 p11 p9;
t7 = manu tet4 p5 p6 p11 p9;
t8 = manu tet4 p1 p5 p11 p9;
*
* Pyramid # 3
*
x12 = (x2 + x3 + x6 + x7) / 4.0;
y12 = (y2 + y3 + y6 + y7) / 4.0;
z12 = (z2 + z3 + z6 + z7) / 4.0;
*
p12 = x12 y12 z12;
t9  = manu tet4 p3 p2 p12 p9;
t10 = manu tet4 p7 p3 p12 p9;
t11 = manu tet4 p6 p7 p12 p9;
t12 = manu tet4 p2 p6 p12 p9;
*
* Pyramid # 4
*
x13 = (x3 + x4 + x7 + x8) / 4.0;
y13 = (y3 + y4 + y7 + y8) / 4.0;
z13 = (z3 + z4 + z7 + z8) / 4.0;
*
p13 = x13 y13 z13;
t13 = manu tet4 p4 p3 p13 p9;
t14 = manu tet4 p3 p7 p13 p9;
t15 = manu tet4 p7 p8 p13 p9;
t16 = manu tet4 p8 p4 p13 p9;
*
* Pyramid # 5
*
x14 = (x1 + x4 + x5 + x8) / 4.0;
y14 = (y1 + y4 + y5 + y8) / 4.0;
z14 = (z1 + z4 + z5 + z8) / 4.0;
*
p14 = x14 y14 z14;
t17 = manu tet4 p1 p4 p14 p9;
t18 = manu tet4 p4 p8 p14 p9;
t19 = manu tet4 p8 p5 p14 p9;
t20 = manu tet4 p5 p1 p14 p9;
*
* Pyramid # 6
*
x15 = (x5 + x6 + x7 + x8) / 4.0;
y15 = (y5 + y6 + y7 + y8) / 4.0;
z15 = (z5 + z6 + z7 + z8) / 4.0;
*
p15 = x15 y15 z15;
t21 = manu tet4 p6 p5 p15 p9;
t22 = manu tet4 p7 p6 p15 p9;
t23 = manu tet4 p8 p7 p15 p9;
t24 = manu tet4 p5 p8 p15 p9;
*
tetr = t1 et t2 et t3 et t4 et t5 et t6
       et t7 et t8 et t9 et t10 et t11 et t12
       et t13 et t14 et t15 et t16 et t17 et t18
       et t19 et t20 et t21 et t22 et t23 et t24;
*
finproc tetr;
```

pxhex2te.proc

```
'DEBPROC' pxhex2te hexa*'MAILLAGE';
*
*--------------------------------------------------
* Splits a hexahedron into 12 tetrahedra.
* First, the hexahedron is split into 6 pyramids,
* one for each face, by introducing an extra node
* at the centre of the hexahedron.
* Then, each pyramid is split into 2 tetrahedra.
* This is done along the plane that passes
* across the node (on the 4-node face of the pyramid)
* with the LOWEST global index, thus possible
* neighbours on the other side of the face will
* be split consistently.
* The advantage of this algorithm is that it is
* independent from the neighbours and yields
* consistent tetrahedra (faces are coincident).
*
* Input :
* -----
*     hexa : a mesh containing just one hexahedron
* Output :
* ------
*     tetr : mesh containing 12 tetrahedra
*--------------------------------------------------
*
hh = chan poi1 hexa;
*h = hh elem 1;
*
p1 = hh poin 1;
p2 = hh poin 2;
p3 = hh poin 3;
p4 = hh poin 4;
p5 = hh poin 5;
p6 = hh poin 6;
p7 = hh poin 7;
p8 = hh poin 8;
*
n1 = noeu p1;
n2 = noeu p2;
n3 = noeu p3;
n4 = noeu p4;
n5 = noeu p5;
n6 = noeu p6;
n7 = noeu p7;
n8 = noeu p8;
*
x1 y1 z1 = coor p1;
x2 y2 z2 = coor p2;
x3 y3 z3 = coor p3;
x4 y4 z4 = coor p4;
x5 y5 z5 = coor p5;
x6 y6 z6 = coor p6;
x7 y7 z7 = coor p7;
x8 y8 z8 = coor p8;
*
x9 = (x1 + x2 + x3 + x4 + x5 + x6 + x7 + x8) / 8.0;
y9 = (y1 + y2 + y3 + y4 + y5 + y6 + y7 + y8) / 8.0;
z9 = (z1 + z2 + z3 + z4 + z5 + z6 + z7 + z8) / 8.0;
*
p9 = x9 y9 z9;
n9 = noeu p9;
*
* Pyramid # 1
*
nlow = n1; ilow = 1;
si ( n2 < nlow ) ; nlow = n2; ilow = 2; finsi;
si ( n6 < nlow ) ; nlow = n6; ilow = 1; finsi;
si ( n5 < nlow ) ; nlow = n5; ilow = 2; finsi;
si (ilow ega 1);
  t1 = manu tet4 p1 p5 p6 p9;
  t2 = manu tet4 p6 p2 p1 p9;
sinon;
  t1 = manu tet4 p2 p1 p5 p9;
  t2 = manu tet4 p5 p6 p2 p9;
finsi;
*
* Pyramid # 2
*
nlow = n2; ilow = 1;
si ( n3 < nlow ) ; nlow = n3; ilow = 2; finsi;
si ( n7 < nlow ) ; nlow = n7; ilow = 1; finsi;
si ( n6 < nlow ) ; nlow = n6; ilow = 2; finsi;
si (ilow ega 1);
  t3 = manu tet4 p2 p6 p7 p9;
  t4 = manu tet4 p7 p3 p2 p9;
sinon;
  t3 = manu tet4 p3 p2 p6 p9;
  t4 = manu tet4 p6 p7 p3 p9;
finsi;
*
* Pyramid # 3
*
nlow = n5; ilow = 1;
si ( n6 < nlow ) ; nlow = n6; ilow = 2; finsi;
si ( n7 < nlow ) ; nlow = n7; ilow = 1; finsi;
si ( n8 < nlow ) ; nlow = n8; ilow = 2; finsi;
si (ilow ega 1);
  t5 = manu tet4 p5 p8 p7 p9;
  t6 = manu tet4 p7 p6 p5 p9;
sinon;
  t5 = manu tet4 p6 p5 p8 p9;
  t6 = manu tet4 p8 p7 p6 p9;
finsi;
```

```
*
* Pyramid # 4
*
nlow = n4; ilow = 1;
si ( n1 < nlow ) ; nlow = n1; ilow = 2; finsi;
si ( n5 < nlow ) ; nlow = n5; ilow = 1; finsi;
si ( n8 < nlow ) ; nlow = n8; ilow = 2; finsi;
si (ilow ega 1);
  t7 = manu tet4 p4 p8 p5 p9;
  t8 = manu tet4 p5 p1 p4 p9;
sinon;
  t7 = manu tet4 p1 p4 p8 p9;
  t8 = manu tet4 p8 p5 p1 p9;
finsi;
*
* Pyramid # 5
*
nlow = n1; ilow = 1;
si ( n2 < nlow ) ; nlow = n2; ilow = 2; finsi;
si ( n3 < nlow ) ; nlow = n3; ilow = 1; finsi;
si ( n4 < nlow ) ; nlow = n4; ilow = 2; finsi;
si (ilow ega 1);
  t9  = manu tet4 p1 p2 p3 p9;
  t10 = manu tet4 p3 p4 p1 p9;
sinon;
  t9  = manu tet4 p4 p1 p2 p9;
  t10 = manu tet4 p2 p3 p4 p9;
finsi;
*
* Pyramid # 6
*
nlow = n3; ilow = 1;
si ( n4 < nlow ) ; nlow = n4; ilow = 2; finsi;
si ( n8 < nlow ) ; nlow = n8; ilow = 1; finsi;
si ( n7 < nlow ) ; nlow = n7; ilow = 2; finsi;
si (ilow ega 1);
  t11 = manu tet4 p3 p7 p8 p9;
  t12 = manu tet4 p8 p4 p3 p9;
sinon;
  t11 = manu tet4 p4 p3 p7 p9;
  t12 = manu tet4 p7 p8 p4 p9;
finsi;
*
tetr = t1 et t2 et t3 et t4 et t5 et t6
       et t7 et t8 et t9 et t10 et t11 et t12;
*
finproc tetr;
```

pxordpoi.proc

```
*$$$$ PXORDPOI
*
* pour ordonner une serie de points PLIN en partant de P1
*
* Input:
* =====
* PLIN = objet MAILLAGE de type POI1 (ligne de points)
* P1   = premier point de la ligne (typ POINT)
*
* Output:
* ======
* PORDO = objet MAILLAGE de type POI1 (ligne de points) contenant
*         les points ordonnes a partir de P1
*
'DEBPROC' PXORDPOI PLIN*'MAILLAGE' P1*'POINT' ;
*-----------------------------------------------------------------
*
PORDO=P1;
PPA=P1;
NE='NBEL' PLIN;
*
I=0;
'REPETER' LAB1 (NE-1);
  I=I + 1;
* mess I;
  PLIN= 'DIFF' ((PPA 'ET' PPA) 'ELEM' 1) PLIN;
  PPA=PLIN 'POIN' 'PROC' PPA;
  PORDO=PORDO 'ET' PPA;
'FIN' LAB1;
*
'FINPROC' PORDO;
```

List of input files

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Abstract

The present work completes the implementation of adaptivity routines by extending them to CEA's fluid finite elements both in 2D (TRIA and CAR1) and in 3D (TETR and CUBE). The CAR1 is treated like other 2D quadrilaterals (Q41L, FL24) as far as geometrical issues are concerned. In addition to the solid case, the activation of adaptivity for fluids requires the suitable treatment of transport terms which arise in the Eulerian or ALE forms of the governing equations. For the CEA's fluid finite elements mentioned above (TRIA, CAR1, TETR and CUBE) this is done in routines tr2me.ff (for the 2D case) and tr3me.ff (for the 3D case), respectively. Therefore, most modifications for the current implementation are concentrated in those two routines. Actually, a special version of the routines is written, valid for the mesh adaptive case.

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