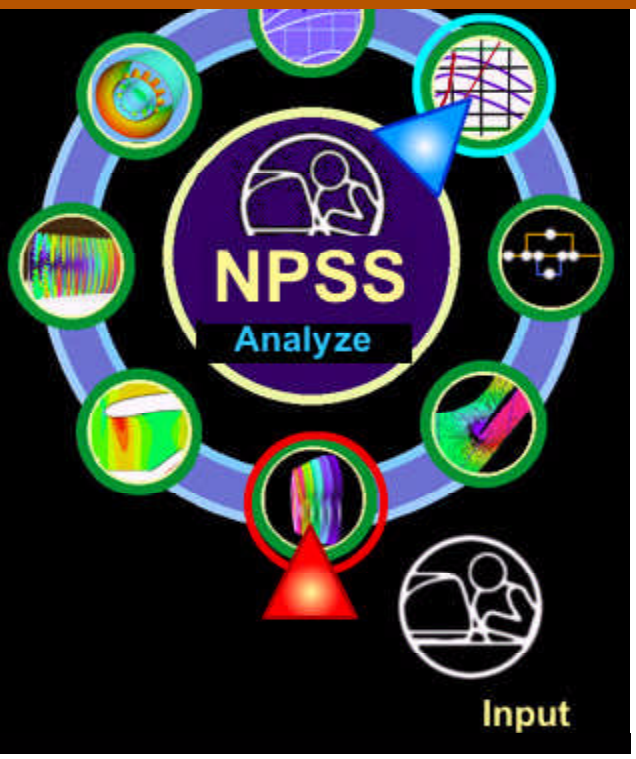

Numerical Propulsion System Simulation--A Common Tool for Aerospace Propulsion Being Developed

The NASA Glenn Research Center is developing an advanced multidisciplinary analysis environment for aerospace propulsion systems called the Numerical Propulsion System Simulation (NPSS). This simulation is initially being used to support aeropropulsion in the analysis and design of aircraft engines. NPSS provides increased flexibility for the user, which reduces the total development time and cost. It is currently being extended to support the Aviation Safety Program and Advanced Space Transportation. NPSS focuses on the integration of multiple disciplines such as aerodynamics, structure, and heat transfer with numerical zooming on component codes. Zooming is the coupling of analyses at various levels of detail. NPSS development includes using the Common Object Request Broker Architecture (CORBA) in the NPSS Developer's Kit to facilitate collaborative engineering. The NPSS Developer's Kit will provide the tools to develop custom components and to use the CORBA capability for zooming to higher fidelity codes, coupling to multidiscipline codes, transmitting secure data, and distributing simulations across different platforms. These powerful capabilities will extend NPSS from a zero-dimensional simulation tool to a multifidelity, multidiscipline system-level simulation tool for the full life cycle of an engine.

The ultimate goal of NPSS is to improve the quality and reduce the development time for aerospace propulsion systems. Currently, interdisciplinary design involves several different types of tools that are not designed to work together. NPSS will streamline and improve this process by providing tighter integration of various tools, with automated translation. This reduces development time and reduces errors due to the manual entry of data. NPSS accelerates the engine system design analysis and test phases, including integration with the airframe, which facilitates bringing the final product to market faster.

By providing an integrated framework within which the various tools can execute and communicate, the NPSS will significantly streamline the design and development process. This will, in turn, shorten the development cycle, giving NPSS users an advantage over other developers.

In the past, at each step in the cycle an expert operator was required to do the following:

1. Read the results of the previous analysis.

2. Analyze the results and decide what changes to their own model are required.
3. Translate the data from the previous analysis for use in the current tool.
4. Manually enter the new input.
5. Run the current tool.
6. Feed the output to the next step or tool in the analysis cycle.

With NPSS

1. Results from the previous analysis are automatically available.
2. Results are analyzed, and model changes are made.
3. Data are automatically translated and available.
4. Any tool can run accessing data with output available.

U.S. aircraft and airframe companies recognize NPSS as the future industry standard common analysis tool for aeropropulsion system modeling. The estimated potential payoff, if NPSS is adopted by the aeronautics industry, is a $50 million/year savings through improved engineering productivity.

Through the NASA/Industry Cooperative Effort agreement, NASA Glenn and industry and Government partners are developing NPSS. The NPSS team consists of propulsion experts and software engineers from GE Aircraft Engines, Pratt & Whitney, the Boeing Company, Honeywell, Rolls-Royce Corporation, Williams International, Teledyne Ryan Aeronautical, Arnold Engineering Development Center, Wright-Patterson Air Force Base, and the NASA Glenn Research Center. Interest in using NPSS continues to broaden from aeropropulsion, both commercial and military, to space transportation and ground-based power systems. Formal software development processes, which are under ISO 9000 high control, are followed to facilitate technology transfer.

In fiscal year 2000, the major accomplishment of the NPSS team was the distribution of NPSS Version 1.0.0 on schedule. NPSS Version 1.0.0 can be used as an aerothermodynamic zero-dimensional cycle simulation tool. The capabilities include text-based input syntax, a sophisticated solver, steady-state and transient operation, report generation, a built-in object-oriented programming language for user-definable components and functions, support for distributed running of external codes via CORBA, test data reduction, interactive debug capability, and customer deck generation.

In fiscal year 2001, we plan to focus on enhancing the NPSS Developer's Kit (providing the initial Visual-Based Syntax (VBS) capability) and on supporting space transportation. NPSS Version 2.0.0 for aerospace is scheduled to be released in fiscal year 2001. NPSS is supported under NASA's High Performance Computing and Communications Program.

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