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The Role of Computers in LaRC R&D
Graphics and Image Processing Session
June 16, 1994

Data Visualization and Animation (DVAL) Overview

Presented by Kathy Stacy and Bill von Ofenheim

Abstract:

The Data Visualization and Animation Lab is an open shop facility created and supported by the Scientific Applications Branch of the Information Systems Division. The DVAL is located in Building 1268, Room 1101A. An experienced team of visualization experts is available to help researchers import, visualize, and interpret data derived from a wide variety of sources including in-flight experiments, wind tunnel tests, computer simulations, and atmospheric studies.

The general capabilities of the DVAL include digital image processing, 3-D interactive computer graphics, data visualization and analysis, video-rate acquisition and processing of video images, photo-realistic modeling and animation, video reports generation, and color hardcopies. The hardware resources of the facility cover a variety of computer platforms including Sun workstations, SGI workstations, PCs, and Macs. The Video Image Processing System (VIPS) is a specialized system designed for post-processing of images recorded to videotape. The system supports the common video formats used at the Center, including VHS, S-VHS, U-Matic, U-Matic SP, and Betacam. The most common application of VIPS is the processing and analysis of video images produced by wind tunnel or in-flight flow visualization experiments. The system allows for video-rate (or 30 frames per second) digitization, processing, storage and retrieval of video frames. The real-time digital disk can store up to eight minutes of digital image data. The video-rate processing includes frame averaging, running averages, frame-by-frame subtraction, pseudocoloring, and spatial convolutions with a kernel size up to eight by eight. The Scientific Visualization System (SVS) is another specialized system for generating broadcast quality video productions. Hardware resources also include a film scanner and flatbed scanner for image input, and graphics hardcopy devices for image output. The software resources include major commercial visualization packages such as PV-WAVE, KB-Vision, SGI Explorer, WAVEFRONT, TECPLOT, Mathematica, and Fieldview, as well as public domain packages and software packages developed in-house.

A sample application which utilizes most of the capabilities of the DVAL is the F-106B Leading-Edge Flow Visualization Experiment. The original data from this experiment were vapor screen images recorded on black and white VHS videotape. Select frames from the videotape were digitized in DVAL using the VIPS system. The 2-D digital images could then be enhanced, and vortex core locations could be located, using PV-WAVE software. A geometric mapping model was developed to accurately map 2-D vapor screen images into 3-D space. The Flow Analysis Software Toolkit (FAST) was used to interactively visualize the 3-D vapor screen image data along with the numerical surface geometry of the F-106B. Computer animations were generated using FAST, and a broadcast quality video containing these animations was produced on the SVS.

One component of DVAL is the Scientific Visualization System (SVS) which

consists of a state-of-the-art digital video editing suite for creating broadcast-quality videos from computer-generated results. These videos are used for analysis, presentation, and dissemination. Video helps the analysis process by providing real-time playback of images which may take hours to create thereby allowing researchers to get a better understanding of their time-dependent results. Video is also a highly portable and universal media for presenting dynamic data at conferences and meetings. Lastly video is an effective mechanism for abetting the technology transfer process by virtue of its inexpensive and self-contained nature.

The philosophy behind the Scientific Visualization System is the preservation of the original image quality. This is accomplished by using digital component video equipment. Digital component video is compatible with digital computers and digital networks so image data suffers no loss during transmission. Also editing and special effects are performed digitally so the integrity of the original image is always maintained.

There are three phases to the video creation process: 1) Pre-Production, 2) Production, and 3) Post-Production. The pre-production phases involves creating a storyboard, writing a script, narrating the script, and adding music. Not all of these steps are required for each video but at minimum each video should start from a storyboard. The production phase involves creation of the images or animations using existing packages (e.g. FAST, Wavefront, and TECPLOT) or special purpose codes written by SVS personnel. The created images/animations are then transferred to SVS either digitally using LaRCNET or via analog means such as SVS's transportable laser disk recording system. Video tapes created using a video camera such as used in wind tunnel and in-flight experiments are another means for production. Finally, the video is edited together in the post-production phase using editing techniques (e.g. fade, dissolve, wipe, etc.), special effects (e.g. warps, split screens, layering, etc.), title generation, paint, and graphics.

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**DATA VISUALIZATION & ANIMATION
LAB (DVAL) OVERVIEW**

Presented by:
Kathy Stacy
Bill von Ofenheim

Background

- Open shop scientific visualization facility
- Located in Building 1268, Room 1101A
- Created and supported by the Scientific Applications Branch of ISD
- Objectives:
 - 1) provide and maintain a state-of-the-art scientific visualization capability at LaRC
 - 2) foster partnerships with LaRC researchers to apply visualization tools and techniques to enhance and enable science investigations

General Capabilities

- **Digital Image Processing**
- **3-D Interactive Computer Graphics**
- **Data Visualization and Analysis**
- **Video-rate acquisition and processing of video images**
- **Photo-realistic Modeling and Animation**
- **Video reports generation**
- **Color Hardcopies**

Resources

- **Hardware Resources:**

Sun workstations, SGI workstations, PC, Mac

Video Image Processing System (VIPS)

Scientific Visualization System (SVS)

Film scanner and flatbed scanner

Access to Production Graphics Hardcopy Devices

- **Software Resources:**

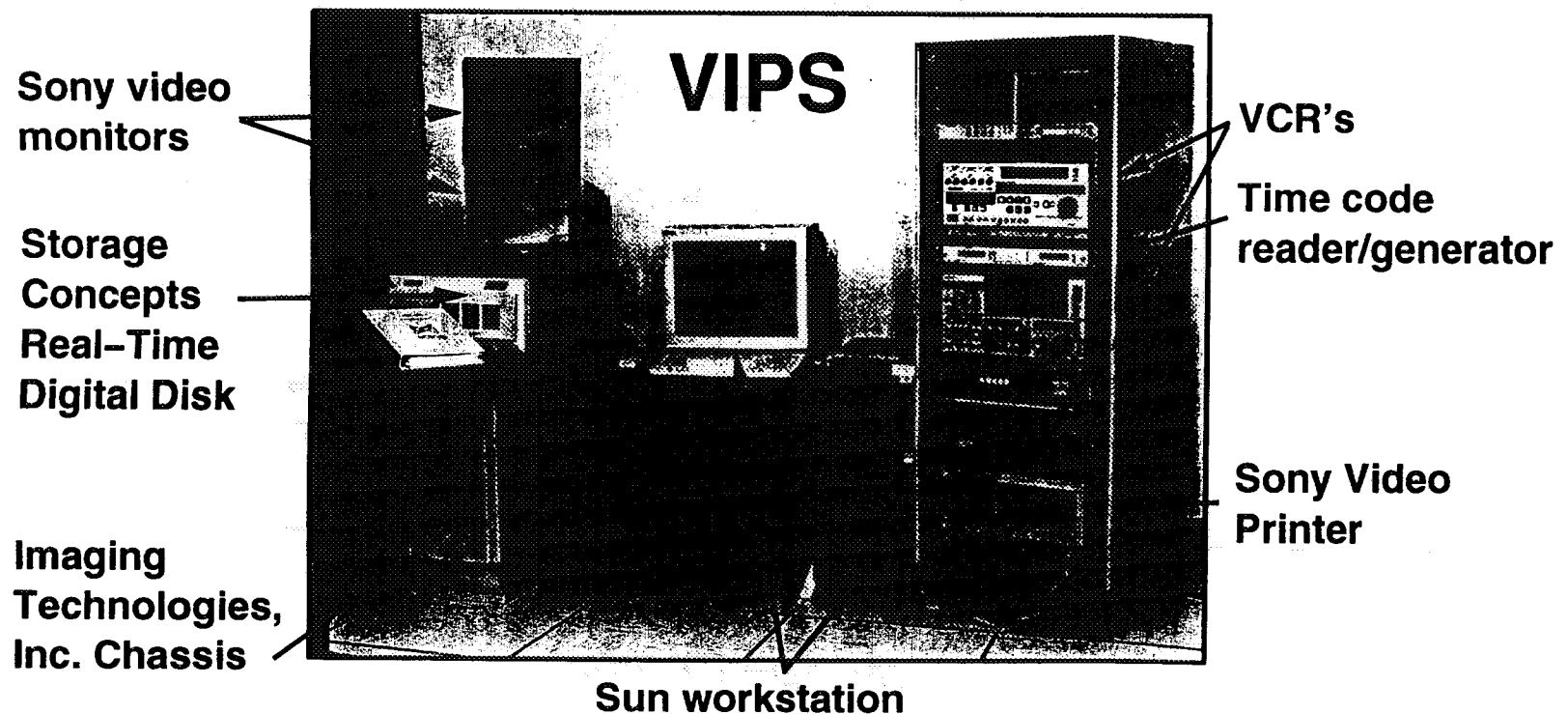
Major commercial packages including PV~WAVE, KB-Vision, SGI Explorer, WAVEFRONT, TECPLOT, Mathematica, Fieldview

Public Domain packages including KHOROS, Xv, Xloadimage

In-house packages including ILLUME, Blobtool, Thrtool

Video Image Processing System

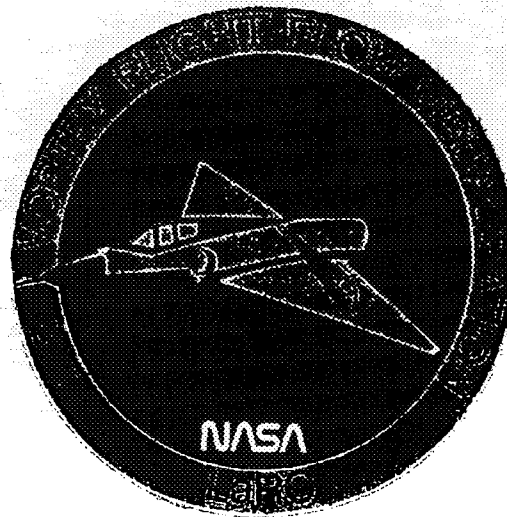
- Designed for post-processing of images recorded to videotape
- Common applications include processing of wind tunnel or in-flight flow visualization experiments recorded on videotape
- Video-rate digitization, processing, storage, and retrieval



DVAL OVERVIEW

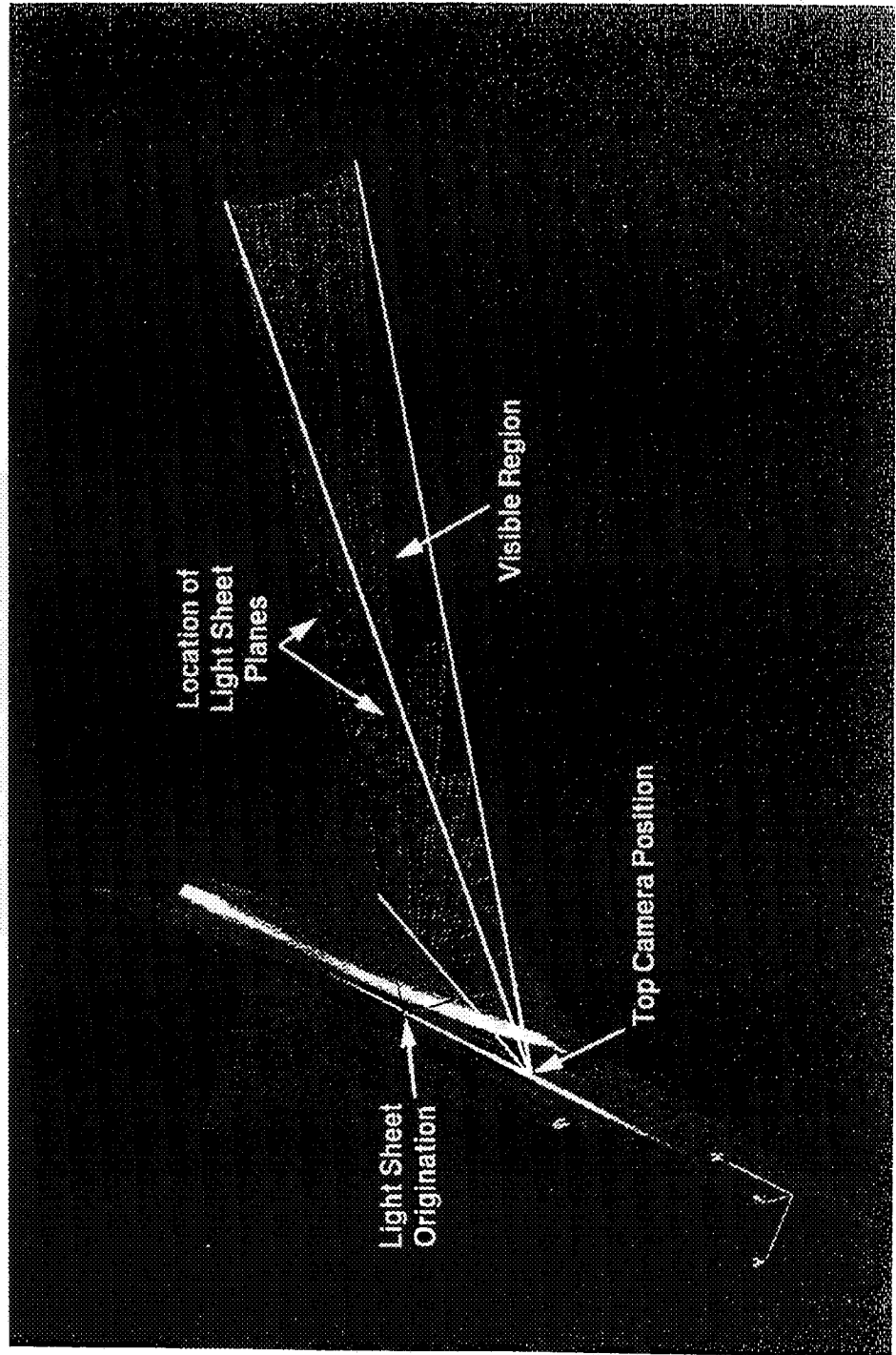
Sample Application

- **F-106B Leading-Edge Flow Visualization Experiment using a Rotating Vapor Screen Technique**
- **Original data source: black & white videotape**
- **DVAL products: a 3-D interactive visual analysis capability
quantitative geometric position information
broadcast quality video**



DVAL OVERVIEW

Sample Application (Cont.)



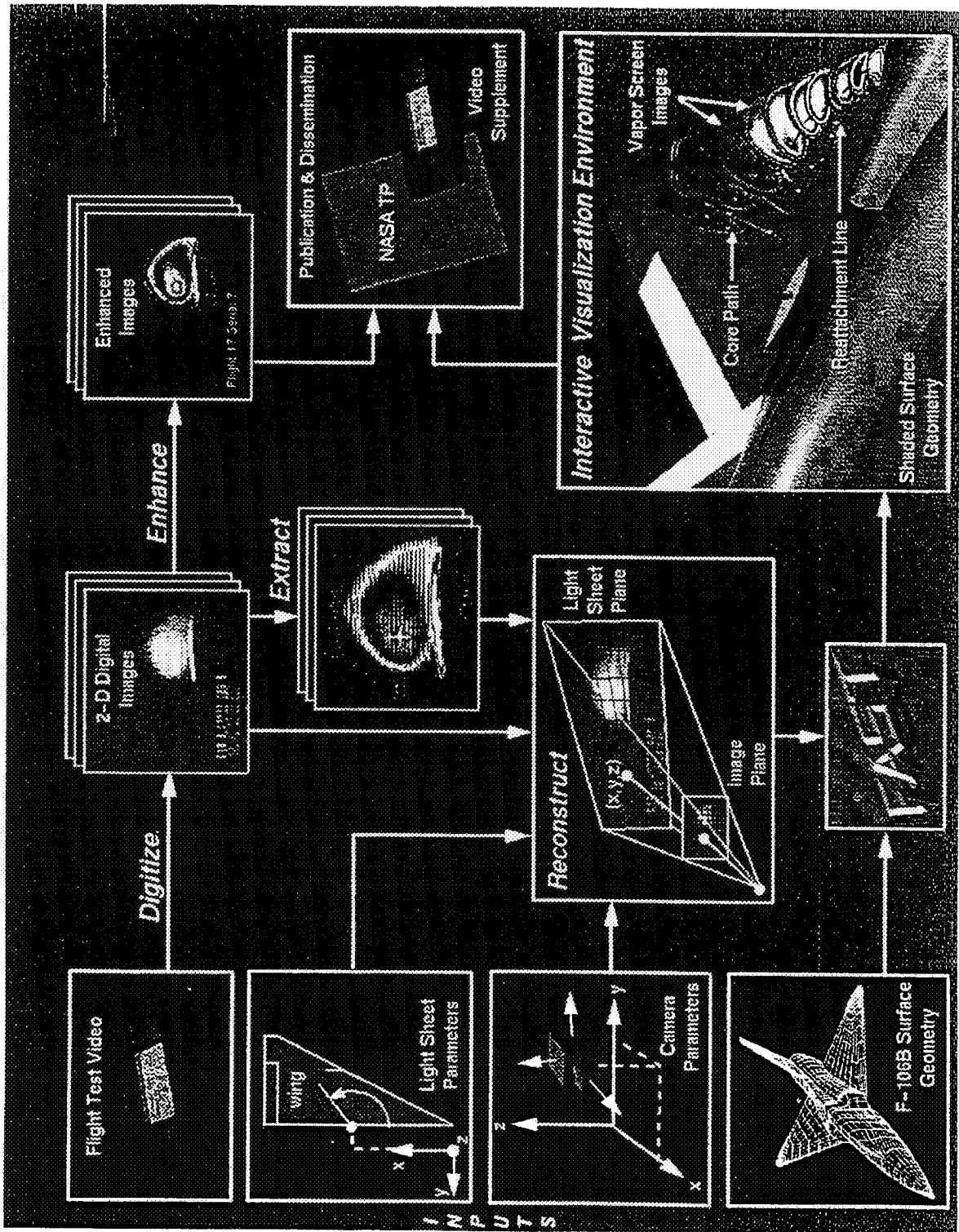
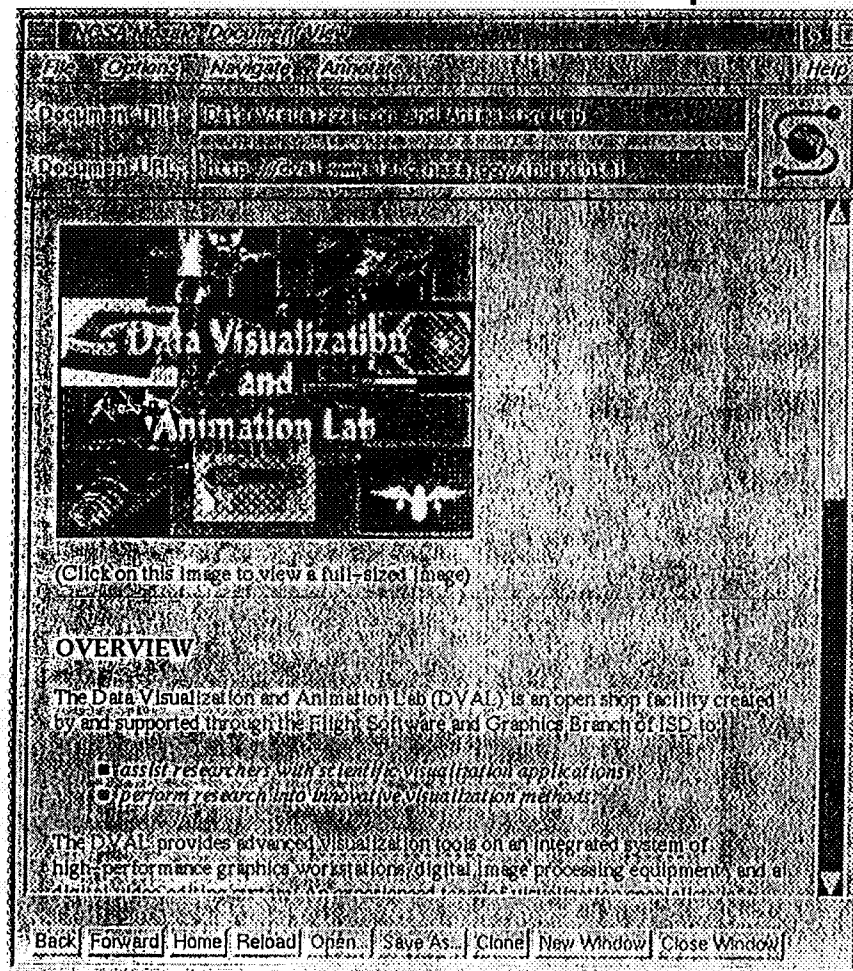


PHOTO COURTESY OF NASA

DVAL OVERVIEW

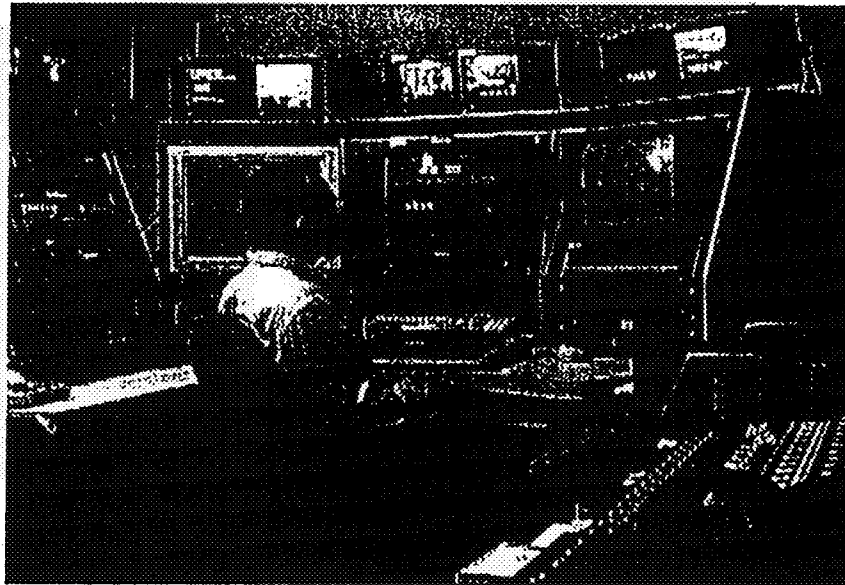
DVAL Mosaic Page

- Up-to-date on-line information about DVAL capabilities



DVAL OVERVIEW

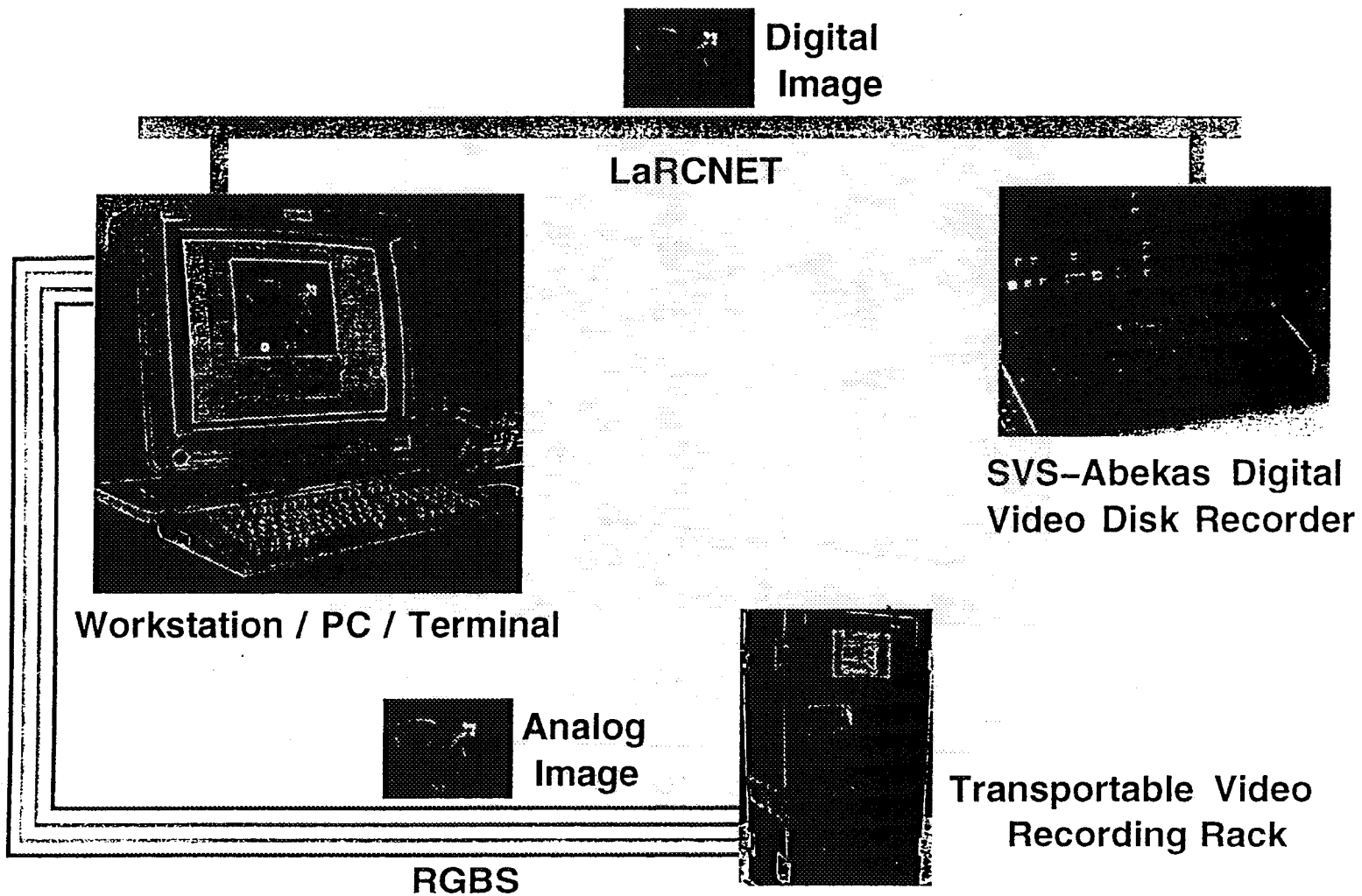
Scientific Visualization System



- Scientific Visualization System (SVS) is a State-of-the-Art Digital Video Editing Suite
- Produce Broadcast-Quality Video Tapes of Computer-Generated Results for :
 - Presentation
 - Analysis
 - Dissemination/Technology Transfer

DVAL OVERVIEW

SVS – Image Acquisition



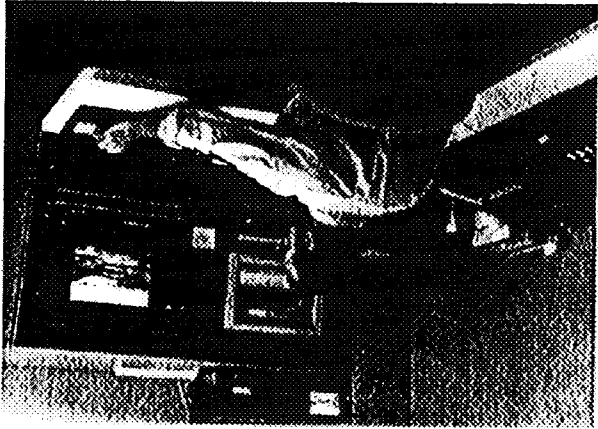
SVS Video Creation

Three Step Process :

- 1) Pre-Production**
- 2) Production**
- 3) Post-Production**

DVAL OVERVIEW

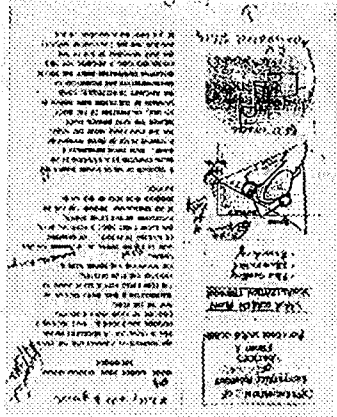
SVS Pre-Production



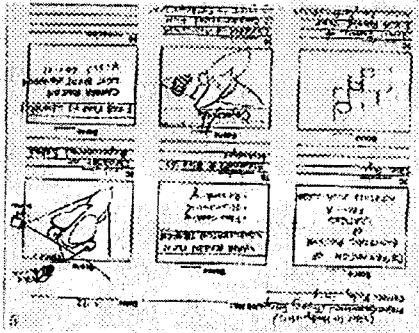
Music



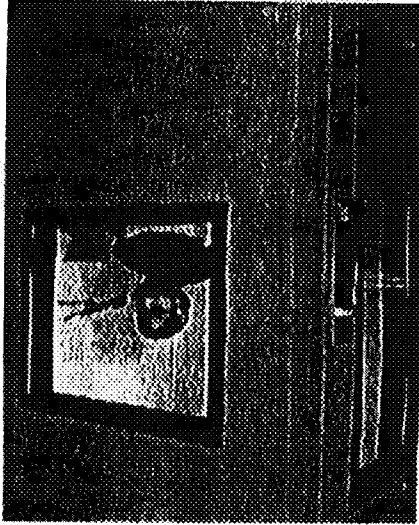
CD Library



**Script Writing
and Revision**



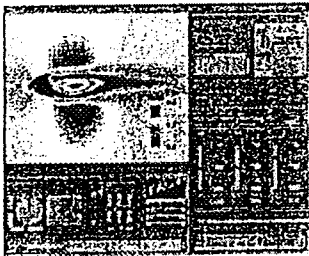
Storyboard Preparation



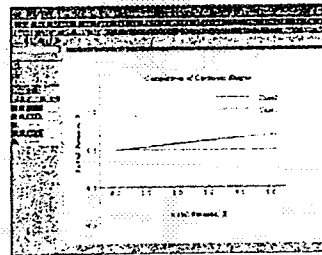
Narration

SVS Production

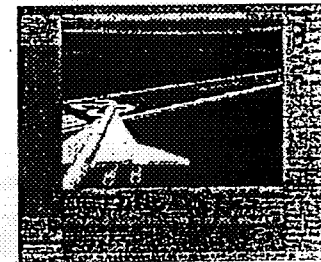
- Computer Programming :
 - Translators
 - Device Drivers
 - Simulators
 - Special Purpose Codes
- Creation of Animations and Images :



FAST



TECPLOT



WAVEFRONT

- Transfer of Images to SVS

SVS Post-Production

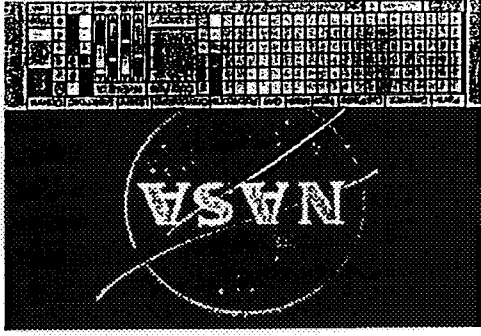
DVAL OVERVIEW

Video Editing :

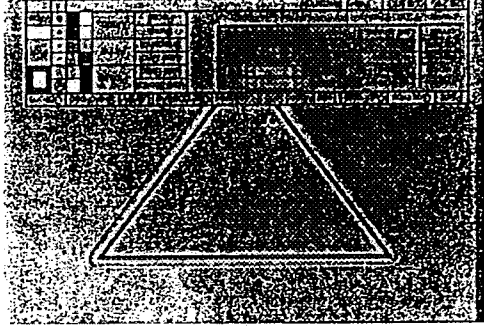
- Cuts
- Fades
- Dissolves
- Wipes



Title Generation

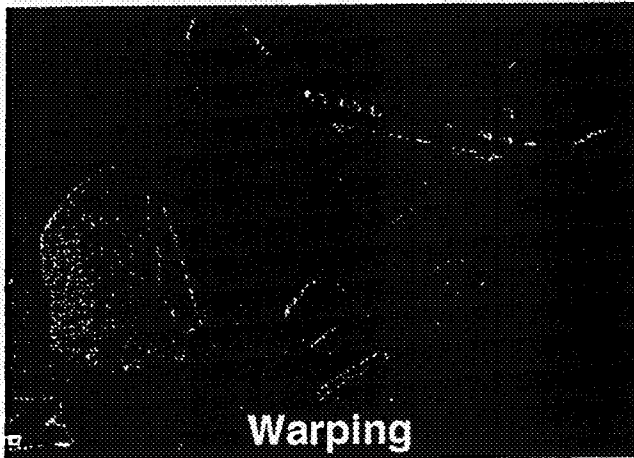


Paint

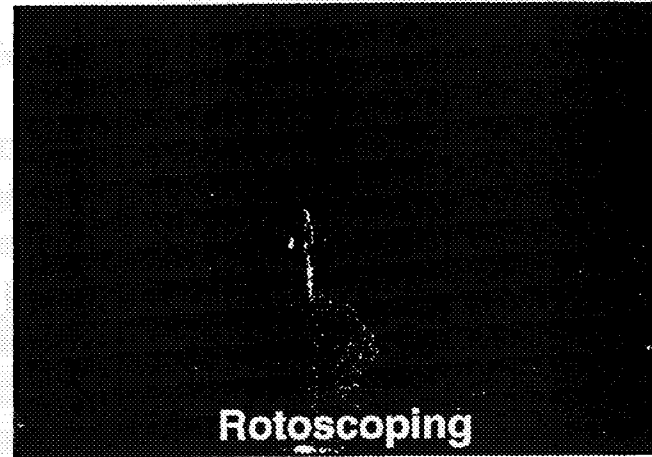


Graphics

SVS Post-Production (Cont.)

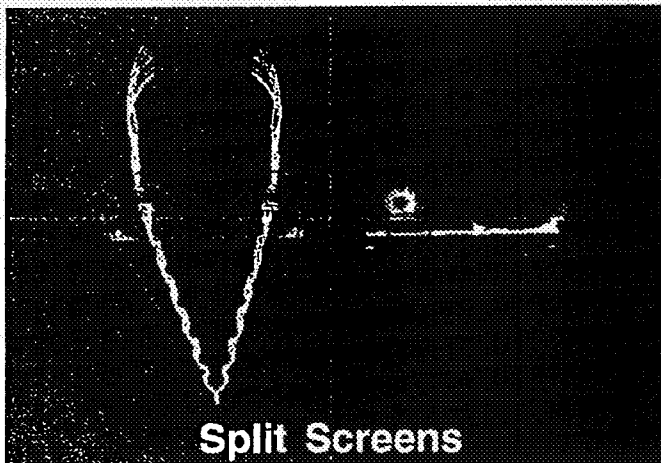


Warping

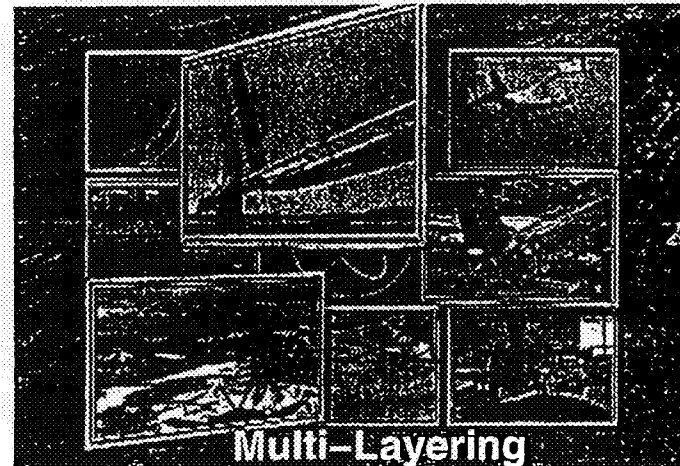


Rotoscoping

Video Special Effects



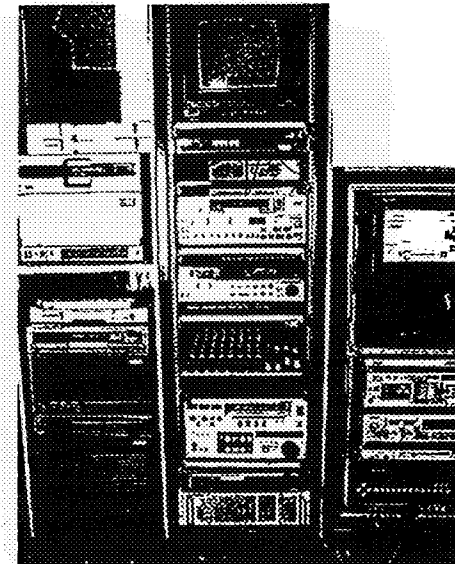
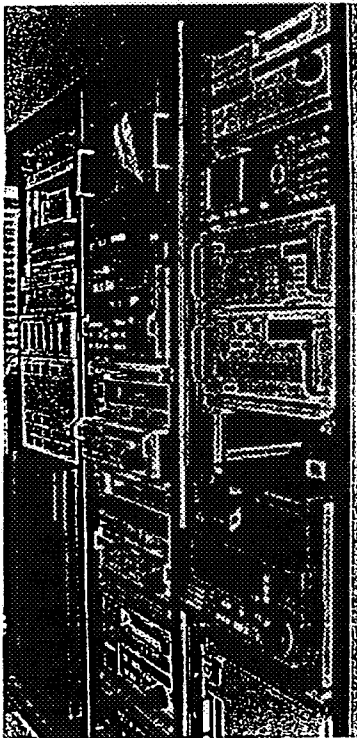
Split Screens



Multi-Layering

SVS Hardware

- DF/X Composium Digital Video Editor
- Abekas Digital Video Disk Recorder (2)
- Sony D1 Digital Video Tape Recorder (2)
- Sony Betacam SP Tape Recorder (2)
- Sony Betacam SP Tape Player
- Sony Laser Disk Recorder (2)
- Sony U-matic SP Tape Recorder
- Sony U-matic Tape Recorder
- Panasonic S-VHS Tape Recorder
- JVC VHS Tape Recorder
- Sharp VHS Tape Recorder
- Sony Audio/Video Editor
- Sony Audio Mixer
- Sony CD Player
- JVC DAT Recorder
- Tascam Audio Cassette Recorder
- Acoustic Systems Narration Booth



DVAL OVERVIEW

SVS Misc.

- Creation of MPEG animations from :
 - Computer-generated images
 - Video tape

- Services and material provided by SVS are free of charge

- Contact :

Bill von Ofenheim
Scientific Applications Branch
Information Systems Division
x46712
w.h.c.vonofenheim@larc.nasa.gov