

Numerical Propulsion System Simulation (NPSS): An Award Winning Propulsion System Simulation Tool



Numerical Propulsion System Simulation designated co-winner of the NASA Software of the Year Award for 2001.

The Numerical Propulsion System Simulation (NPSS) is a full propulsion system simulation tool used by aerospace engineers to predict and analyze the aerothermodynamic behavior of commercial jet aircraft, military applications, and space transportation. The NPSS framework was developed to support aerospace, but other applications are already leveraging the initial capabilities, such as aviation safety, ground-based power, and alternative energy conversion devices such as fuel cells. By using the framework and developing the necessary components, future applications that NPSS could support include nuclear power, water treatment, biomedicine, chemical processing, and marine propulsion. NPSS will dramatically reduce the time, effort, and expense necessary to design and test jet engines. It accomplishes that by generating sophisticated computer simulations of an aerospace object or system, thus enabling engineers to "test" various design options without having to conduct costly, time-consuming real-life tests. The ultimate goal of NPSS is to create a numerical "test cell" that enables engineers to create complete engine simulations overnight on cost-effective computing platforms. Using NPSS, engine designers will be able to analyze different parts of the engine simultaneously, perform different types of analysis simultaneously (e.g., aerodynamic and structural), and perform analysis in a more efficient and less costly manner.

NPSS will cut the development time of a new engine in half, from 10 years to 5 years. And NPSS will have a similar effect on the cost of development: new jet engines will cost about a billion dollars to develop rather than two billion. NPSS is also being applied to the development of space transportation technologies, and it is expected that similar efficiencies and cost savings will result.

Advancements of NPSS in fiscal year 2001 included enhancing the NPSS Developer's Kit to easily integrate external components of varying fidelities, providing the initial Visual-Based Syntax (VBS) capability, and developing additional capabilities to support space transportation. NPSS was supported under NASA's High Performance Computing and Communications Program.

Through the NASA/Industry Cooperative Effort agreement, NASA Glenn and its 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 Continental Motors, Arnold Engineering Development Center, Wright Patterson Air Force Base, and the NASA Glenn Research Center.

Glenn is leading the way in developing NPSS--a method for solving complex design problems that's faster, better, and cheaper.

Bibliography

Follen, G.J.: An Object Oriented Extensible Architecture for Affordable Aerospace Propulsion Systems. To be presented in Paris, France, Spring 2002.

Follen, G.; and auBuchon, M.: Numerical Zooming Between the NPSS Version 1 and a One-Dimensional Meanline Design Analysis Code. ISABE Paper 99-7196, 1999.

Binder, M.: Numerical Propulsion System Simulation Introduction. Multimedia CD, mbinder@reality-alt.com, Washington DC, 2001.

Evans, A.L., et al.: Numerical Propulsion System Simulation's National Cycle Program. AIAA Paper 98-3113, 1998.

Ashleman, Russell H., Jr.; Lavelle, Thomas; and Parsons, Frank: The National Cycle Program: A Flexible System Modeling Architecture. AIAA Paper 98-3114, 1998.

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Special recognition: In 2001, the NPSS team won the 2001 NASA Office of Aerospace Technology (OAT) Turning Goals into Reality (TGIR) Award for Goal 3 Pioneering Technology Innovation, was co-winner of the NASA 2001 Software of the Year Award (SOYA), and was a finalist to CrossTalk: The Journal of Defense Software Engineering TOP 5 Software Projects for 2001. NPSS Version 1.0 was selected as one of the top 16 Government Software Projects for 2001 out of 87 nominees.