



# The Predictor

Iteration 4 Substep 1

June 1997

A NEWSLETTER FOR THE NPARC USERS ASSOCIATION

## From the Support Team

The NPARC WWW Home Page has been updated with Version 3.0 of the user's manual. Also available are the latest newsletters, reference updates, and the FY97 Plans and Policies. Coming shortly are some additions to the validation archive.

In case you haven't visited our home page recently, you might give it a look. In previous years, a users survey was conducted via mail. We're trying for the first time to do this electronically. At the time of this publication, we have had 19 of the 100+ users respond. Your input is used in the planning process to set priorities of what new developments are added, what types of validation cases are done, and what type of support you would like as a user. Your input also lets us know if we are on the right track as an Alliance. It's real easy to point and click. Give it a try!

The third NPARC workshop was held in May to develop the "roadmap" for FY98 Alliance activities. See the lead article on the workshop written by our fearless leaders.

To let us know what you think or for support questions, the NPARC support team can be contacted at:

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## The Third NPARC Alliance Workshop

The NPARC Alliance relies heavily on users and developers of the NPARC software to participate in the planning process for future support, development, and validation activities. An important event in this process is the annual NPARC Alliance Workshop. This year's workshop attracted 30 participants from government (AEDC and NASA LeRC), industry (Boeing, McDonnell Douglas, and Lockheed-Martin), and academia (UTSI).

The primary objective of this two day workshop was to draft the working document of the NPARC Alliance, the FY98 Policies and Plans. This document clearly states the policies of the NPARC Alliance and specific plans in the areas of support, validation, and development of NPARC software.

This year's event was once again held at the Gossick Leadership Center on beautiful Woods Reservoir near AEDC. On the first day, after reviewing the current status of the NPARC Alliance, participants were broken into teams to brainstorm on the future state of the Alliance in 2002. The four teams presented their views in the form of an infomercial. In spite of, or maybe because of, this humorous approach, some interesting views on the direction of the NPARC Alliance were presented.

Next, the attendees determined what issues would have to be resolved to reach this future and what strategies

could be employed to take advantage of opportunities and overcome obstacles. Finally, specific plans and policy changes were proposed to chart the next two years of the NPARC Alliance.

As usual, there was plenty of discussion and controversy, but, in the end, the participants felt that the Alliance was continuing on course. The next annual correction to this course will be at the Fourth NPARC Alliance Workshop to be held in May of 1998.

## Inspector General Lauds NPARC Team

**A**EDC recently passed the Air Force Material Command Inspector General (IG) inspection with flying colors ("Excellent" rating). As part of the inspection, the AEDC commander nominated a number of individuals and teams as Outstanding Performers. One of these teams was the NPARC team. At the completion of their inspection, the IG announced that they agreed with the Commander's recommendation! This is a reflection on the entire NPARC Team to include those at NASA and our industry partners. THANKS FOR A JOB WELL DONE!!!

## Next Generation Flow Solver On- Track

**A**s reported in the Corrector Newsletter in January, major changes in the NPARC Alliance flow solver are underway. The capabilities of three widely-used,

production-oriented CFD flow solver codes are being merged into a single simulation platform. In addition to the NPARC code, the considerable capabilities of the NASTD code from McDonnell Douglas and the XAIR code from AEDC are to be available to NPARC users.

Technology offered by NASTD includes a GUI front-end for boundary condition setting, a combination of overlapped grid and blocked grid boundaries, and advanced turbulence models. In addition, expansion to unstructured grids and reacting flow physics is envisioned.

The NXAIR code has been used for years to predict the complex, unsteady flows associated with store separation. The technologies required for these demanding applications will be available in the final NPARC Alliance code, including: moving, overlapped grid capability, an advanced, fast time-accurate algorithm, and turbulent wall functions.

The entire development is being accomplished between NASA LeRC, the Air Force AEDC, and McDonnell Douglas using an Internet Version Management System (IVMS) developed at McDonnell Douglas. This system provides Internet access to the source and executables, allowing developers to check-out and lock files for modification and providing a mechanism for tracking development threads. This experiment in multi-site development will hopefully lead to more coordination in the future among all NPARC developers.

The current schedule calls for a Beta release of the code near the end of the summer with a final release at the end of January 1998. Based on the progress to date, this schedule should be met. Our next newsletter and the User's meeting scheduled for Reno '98 will have all of the details. As we get

closer, look for updates on our WWW site.

## Validation Activities

**T**he recent NPARC Workshop focused attention on planning activities for FY 98 in the Alliance's three key areas of support, development and validation. The three primary needs that arose from the validation discussions were 1) expansion of the validation effort to encompass the new capabilities embodied in the merged code, 2) the need to quickly build confidence in the new code to facilitate rapid replacement throughout the Alliance user community and 3) moving to the next step in the development of the validation archive, that of going beyond the archiving of results to investigate ways to enhance the archive's usefulness to users seeking guidance on how to approach their application needs.

Relative to the validation needs of the merged code, the code merger activity will create a tool with greatly expanded capabilities such as a more efficient time-accurate capability, the ability to simulate flows about bodies in relative motion and reacting chemistry. This will drive a requirement to include validation cases that address these new capabilities.

An additional driver in selecting the new validation cases will be the demonstration of the code's applicability to a much broader class of aerospace flowfield simulations than NPARC's traditional focus on propulsion integration issues.

Given the significant departure from NPARC Version 3.0, another impact of the release of the merged code will be the need to rapidly build the base of

confidence in the new code to facilitate transition to widespread use of this new tool both at the primary development sites (e.g., NASA Lewis, AEDC, McDonnell Douglas, Boeing) as well as within the broader user community. Since the perception of the maturity of a code's state of validation is based in large part upon accumulated experience in solving a wide variety of fluid dynamic problems, it will be necessary to quickly re-execute both the existing as well as the new validation problems.

Re-execution of existing cases will serve two purposes; the most obvious will be to support the building of confidence in the code results. However, this effort will also serve as a training vehicle for development and support personnel to permit them to quickly move to a position of being able to maintain the level of code support now provided with Version 3.0.

Lastly, efforts to date in the creation and maintenance of the validation archive have focused around the development of the archive structure and standardizing the content format. For the upcoming year, the additional focus of improving the interface to the information will be added. The intent is to better meet the needs of a user with a new application answering the question "what is the best way to approach the solution to this problem and what level of accuracy might I expect to achieve". All in all, the upcoming year will be a challenging time for the entire NPARC Team.

The URL for the NPARC validation archive is

[http://info.arnold.af.mil/nparc/Archive\\_information.html](http://info.arnold.af.mil/nparc/Archive_information.html)

## A Brief Summary of the NPARC Technical Session in Reno

A technical session devoted to recent advances in the development and application of the NPARC code was held at the 35<sup>th</sup> AIAA Aerospace Sciences Meeting in January 1997. Attendance was excellent, from 30 to 50 attendees. Presentations were made by government and university organizations.

Two papers were presented on parallelization of the NPARC code. The paper (97-0026) presented by S. Townsend of NASA LeRC summarized the block parallel implementation in NPARC Version 3.0. Nearly ideal speed-up was indicated for reasonably balanced grid block dimensions. A. Ecer of Purdue presented the second paper (97-0027) on a parallel implementation approach of NPARC on a block basis, but is different from V3.0 master-worker paradigm. Purdue has developed a library, that is easily hooked into any computational method, which controls load balancing and peer-to-peer block interface communications.

S. Yungster from NASA/LeRC presented results of a simulation of a hypersonic inlet in a rocket-based combined-cycle engine (97-0028). His work demonstrated the effect of back pressure on inlet shock structure.

J. Chalk discussed a three-dimensional compression system simulation which was constructed using NPARC (97-0992). Source terms calculated by a one-dimensional stage characteristic technique were used to model the effects of turbomachinery. The

simulation was validated using a single transonic compressor rotor.

A presentation by Prof. A. Hamed of the Univ. of Cincinnati covered the application of NPARC to a candidate HSCT 2DCD nozzle including 3D viscous effects (97-0030). Interesting complex flow structures were simulated indicating the effects of sidewall interaction on nozzle performance.

Finally a paper by P. Espina of NIST was presented that focused on the simulation of supersonic base flow (97-0032). Discussion with P. Espina indicated that the adaptive grid program SAGE from NASA Ames provided significant improvement in shock capturing and was quite easy to implement. He also indicated that modifications to treat low Mach number flows would be very useful. He has attempted to implement preconditioning in NPARC for this purpose, but success was configuration dependent.

## User Association Meetings

The 8<sup>th</sup> NPARC User's Association Meeting was held in conjunction with the AIAA Aerospace Sciences Conference during the January meeting in Reno, Nevada. The gathering was attended by approximately 30 attendees from industry, university and government organizations. The meeting provided a forum for familiarizing users and software vendors with the vision, mission, structure and latest plans and policies of the NPARC Alliance.

A flow simulation system comprising of the geometry and grid tools, a flow solver, and analysis tools was discussed. The previous alliance policy was to recommend auxiliary tools for grid generation and flow

visualization and to develop on an ad hoc basis these tool interfaces. The new alliance policy is to better coordinate with the auxiliary tool vendors and to develop and support interface standards. Vendors from Intelligent Light, Pointwise Inc., and GRIDPRO were able to attend. Discussions with other vendors were held off-line in the exhibit hall. The software vendors were supportive of the efforts of the NPARC Alliance to work with them in defining interface standards for interacting with the pre- and post-processing software packages.

A review of the status of the Support, Development and Validation activities was also presented. The item receiving the greatest attention was the development plans for FY 97. For details of these plans please read the article above entitled "Next Generation Flow Solver On-track".

The following is a list of upcoming NPARC User's Association meetings:

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July 6-9, 1997  
AIAA Joint Propulsion Conference  
Lake Buena Vista, FL

NPARC User's Meeting

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January, 1998  
AIAA Aerospace Sciences Meeting  
Reno, NV

One NPARC Technical Session  
NPARC User's Meeting

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Please plan to attend one of the User's meetings to let your views be known. You are also encouraged to contribute to the NPARC technical sessions to communicate your experiences to other users.

## Frequently Asked Questions

The following are some of the more frequently asked questions of the user support team.

**When will the next generation flow solver be officially released to the NPARC user community?**

The current schedule calls for a Beta release of the code near the end of the summer with a final release at the end of January 1998. Based on the progress to date, this schedule should be met. Our next newsletter and the User's meeting scheduled for Reno '98 will have all of the details. As we get closer, look for updates on our WWW site.

**Once the next generation flow solver is released, How long will the Alliance support NPARC V3.0? Will any training be offered for the next flow solver?**

NPARC V3.0 will be supported by the Support Team of the Alliance through the end of 1998. Software tools will be provided to allow a certain level of backward-compatibility with NPARC V3.0. It is recommended that the new code be acquired as soon as available to start the transition process. If needed by the user community, training for the new code is planned about 6 months after its initial release. This should allow users time to get familiar with the code.

**What is the best way to keep track of the latest information (i.e. bug fixes, code enhancements, upcoming events) from the Alliance?**

"HOTNEWS" located on the NPARC WWW's home page is always a good

place to check first for the latest Alliance information. After the recent workshop (see article above), recommendations were made to use this means of communication more efficiently. It's a good idea. We will.

Also a majordomo mailing list has been created to communicate more efficiently with the NPARC user community. If you have not received any email from this and would like to be added to the list, please email the NPARC Support Team (*nparc-support@info.arnold.af.mil*) with your email address.

## NOTES