2005 JASON Summer Study

Verification and Validation Charge

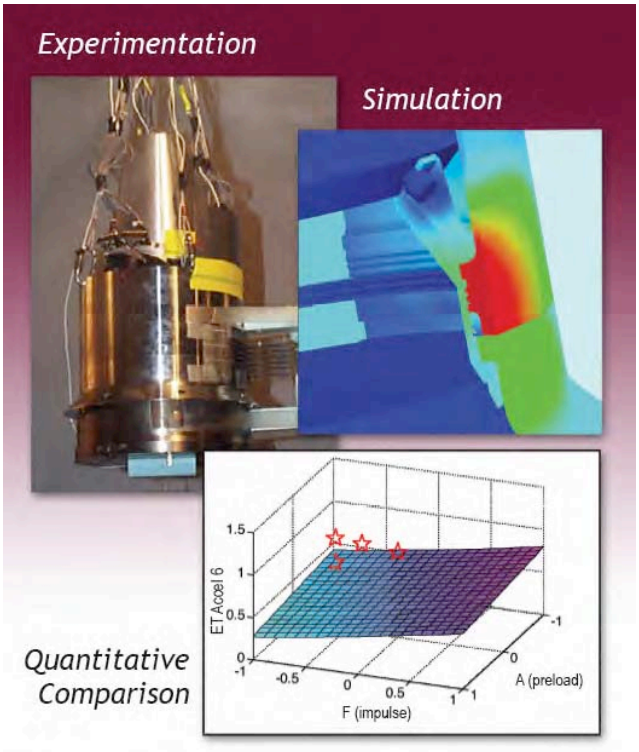
Program Summary

The Advanced Simulation and Computing (ASC) Program has been driven since its inception by the need to ensure the safety, reliability and performance of the nuclear weapons stockpile without nuclear testing through the development of simulation and modeling capability and the deployment of that capability on state-of-the-art high performance computing platforms. As the devices in the stockpile age and as necessary changes are made with technologies or materials that are new to the stockpile, simulation can give laboratory experts, policy makers and DoD customers increased confidence that the nuclear weapons in the stockpile will perform as expected.

The stockpile stewardship program's increasing reliance on simulation tools demands that it be able to affirm the fidelity of those tools and models. In response to these demands, NNSA's new ASC strategy emphasizes a deeper understanding of the underlying science through a replacement of the phenomenology in the weapon simulation codes by better theoretical models and a better understanding of their limitations. The goal of this strategy is significant improvement in the quality of these codes, grounding them on a solid scientific foundation with a quantitative understanding of limitations in capabilities and ranges of application.

Purpose of This Study

JASON is being asked to study in detail the methods of verification and validation of simulation codes as currently employed by the ASC program for stockpile stewardship; provide an analysis as to the efficacy of these current methods and practices in guiding ASC toward an enhanced predictive capability; propose and evaluate additional metrics that could be used to assess code fidelity and predictive capability in a quantitative manner; and comment and advise on the role of small, medium and large scale experiments in supporting the validation process.



The Verification and Validation process ties together simulation and experiments using quantitative comparisons.

Some of the questions that should be addressed in this study include:

1. How are the algorithms and models of the relevant physics that are employed in ASC codes assessed and verified? Are there quantitative measures that be used to assess this aspect of verification?
2. Are quantitative measures available for describing agreement or lack thereof between experiments and simulations that can guide the validation process? Can these be used to suggest and prioritize further experiments to reduce uncertainties?
3. Are there tools and methods that can be employed to assess progress toward enhancing predictive scientific capability and reducing the level of empiricism of the models used in ASC codes?
4. How could the ASC program demonstrate the fidelity of their tools and methods to gain more rapid acceptance and to be of most benefit to the designer community?