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Overview of the JMP Program's CTH and Sierra tasks and their impact on Sandia's Mission

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An overview of two projects within the Joint Munitions Program will be presented. They are the Shock Physics Code and Model Development Project and the Multi-physics Modeling of Strategic Structures Subjected to Terminal Ballistics and/or Blast Project. Two detailed briefs will be given on the Sandia codes CTH and Sierra with a focus on benefit to the NNSA, as described below.

CTH

Shock physics codes satisfy a core competency to the NNSA to help understand questions in energetic material behavior, hypervelocity impact, and resulting high-strain rate mechanical response including failure. The shock physics code CTH has been proven and validated on these problems and provides an often used capability for design, analysis, and interpretation of experiments in the high strain rate regime. It is widely used within NNSA labs and at DoD Labs, DoD High Performance Computing Centers and contractors for conventional weapon design, defeat and safety. The balance of users between NNSA and DoD produces a robust validation regimen and greater agility when addressing future problems. In conjunction with the substantial validation activities in the Joint Munitions Program (JMP), we've identified CTH software development activities targeted to improve underlying code robustness, accuracy and performance while adding state-of-the-art capabilities with mutual NNSA/DoD benefit.

Sierra Coupled Physics

Many important analysis problems in national security arise from the coupling of disparate physical responses, e.g., a shock loading propagating through a structured Eulerian reference frame into a structure or system best analyzed via Lagrangian mechanics. Other important problems arise from a coupling of time or spatial scales within a single physics domain, e.g., penetration problems where a high-speed transient impact is followed by a longer-duration structural response, and where each produces pervasive failure mechanisms that span a range of spatial scales. And still other important problems arise from coupling of different physics in the same reference frame, e.g., thermal-mechanical couplings that develop when weapons systems are subjected to fires or other abnormal environmental effects.

In each of these cases, an essential computational capability is the ability to couple disparate code components, ranging from low-level material libraries to entire high-level applications codes such as CTH. The Sierra application suite includes a wide variety of solid mechanics, fluid dynamics, and thermal analysis tools, and Sierra also provides coupling capabilities so that these tools can be combined with other Sierra capabilities, and with other applications to provide reliable simulation tools for accurate and timely national security analyses.