Abstract Submitted
for the SHOCK17 Meeting of
The American Physical Society

Computationally efficient optimization of radiation drives[1]
GEORGE ZIMMERMAN, DAMIAN SWIFT, Lawrence Livermore National Laboratory — For many applications of pulsed radiation, the temporal pulse shape is designed to induce a desired time-history of conditions. This optimization is normally performed using multi-physics simulations of the system, adjusting the shape until the desired response is induced. These simulations may be computationally intensive, and iterative forward optimization is then expensive and slow. In principle, a simulation program could be modified to adjust the radiation drive automatically until the desired instantaneous response is achieved, but this may be impracticable in a complicated multi-physics program. However, the computational time increment is typically much shorter than the time scale of changes in the desired response, so the radiation intensity can be adjusted so that the response tends toward the desired value. This relaxed in-situ optimization method can give an adequate design for a pulse shape in a single forward simulation, giving a typical gain in computational efficiency of tens to thousands. This approach was demonstrated for the design of laser pulse shapes to induce ramp loading to high pressure in target assemblies where different components had significantly different mechanical impedance, requiring careful pulse shaping.

[1]This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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Date submitted: 27 Feb 2017 Electronic form version 1.4