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Optimal Control of Shock Tube Flow via Water Addition with Application to Ignition Overpressure Mitigation in Launch Vehicles NATHAN MOSHMAN, Naval Postgraduate School — Ignition Overpressure (IOP) in launch vehicles occurs at the start of ignition when a steep rise in pressure propagates outward from the rocket nozzle. It is crucial to minimize the overpressure so as to decrease risk of damage to the rocket body. Currently, CFD studies exist on this situation but there are no optimization studies of the water addition as a means to suppress the IOP. The proposed dissertation will use a numerical method to compute an approximate solution for an optimal control problem constrained by the one-dimensional Euler PDEs of fluid dynamics as well as volume fraction conservation. A model for inter-phase transport of mass momentum and energy and fluid interface quantities will be given. The control will be water addition from external nozzles. The adjoint system of equations will be derived and discretized. Necessary optimal conditions will be derived. An SQP method will solve an optimal situation. Predictions will be validated against shock tube experiments at the NPS rocket lab.

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