

# ADVANCED GUIDANCE ALGORITHMS FOR THE ARES V CARGO LAUNCH VEHICLE

Shelly Su

Dr. Craig A. Kluever, Thesis Supervisor

## ABSTRACT

Launch ascent guidance is an area that routinely involves applications of optimization tools and optimal control theory. The vacuum ascent trajectory problem has been formulated as a two-point boundary-value problem with an interior-point state constraint and is solved with a method of direct parameter optimization. The direct method simplifies the more complicated full costate problem and an off-line trajectory optimization routine for the Ares V Cargo Launch Vehicle (CaLV) shows optimal performance as compared to trajectory simulations performed in the industry standard software, Optimal Trajectories by Implicit Simulation (OTIS). The guidance solution may also be determined through an analytic method, developed by assuming polynomial approximations for the steering profiles and flight-path angle profiles. The analytic solutions prove to be useful when applied to the Shuttle-based Powered Explicit Guidance (PEG) routine, where the results have been shown to converge to near a near optimal trajectory.