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Numerical simulation of pulse operation and performance of a single-tube air-breathing PDE in flight conditions

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The operation process based on repeated DDT and thrust performances of air-breathing propane-fueled PDE in flight conditions have been simulated numerically. A PDE-based axisymmetric vehicle with supersonic air intake, bypass channel, mechanical valve, and nozzle, flying at Mach 3.0 at the altitude 9.3 km was considered. The DDT run-up distance and time in such conditions were shown to be so short that the engine could be quite compact with the total length of about 1.8 m and could operate with positive thrust at a frequency of 100 Hz and very low detonation ignition energy. The fuel-based specific impulse was estimated to be about 2150 s, which is 15%–25% higher than the specific impulse characteristic for hydrocarbon-fueled ramjets.