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Analysis of mode transition in Rotating Detonation Engines using detailed numerical simulations PRASHANT TAREY, PRAVEEN RAMAPRABHU, University of North Carolina, Charlotte, JACOB MCFARLAND, University of Missouri, Columbia, DOUGLAS SCHWER, Naval Research Laboratory, Washington DC — Detonation Engines (RDE) can operate in single or multiple detonation wave modes, while the mode of operation depends on several factors including the equivalence ratio, mass flow rate etc. In this work, we analyze the mechanism of mode transition through detailed numerical simulations of a 2D unrolled RDE geometry with discrete injectors. We systematically vary the equivalence ratio of the hydrogen-air mixture in our simulations with 1-step chemistry. The different modes of operation and the parameter boundaries separating them, were investigated and compared with experimental[1] results. Our results show that the number of waves is proportional to the equivalence ratio as well as the detonation cell width. The effect of the detonation modes on thrust and detonation height were also investigated. The compressible Euler simulations were solved on a Cartesian grid with Adaptive Mesh Refinement, using the Piecewise Parabolic Method (FLASH[2]), while a second-order accurate, Immersed Boundary Method was implemented to model the discrete injectors. [1]A. George et al., Proc. Comb. Inst., 36 (2), 2691, (2017). [2]B. Fryxell et al., Astrophys. J., Suppl. Ser. 131, 273 (2000).

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