Understanding Wave Features in Rotating Detonation Engines

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Detonation waves in non-premixed implementations of rotating detonation engines (RDEs) exhibit unique spatial structure that is central to the practical realizability of such systems. In particular, the response of such wave structure to changes in inflow and operating conditions is studied here. It is well known, based on pioneering works of Prof. Wolanski and others, that increasing the mass flow rate to an RDE increases the number of waves, albeit in discrete jumps. Here, the progression towards such changes in wave modes is analyzed numerically. The UM axial injection flow configuration is used for this purpose. It is shown that as the mass flow is increased by increasing the plenum pressures , the inflow jets penetrate farther into the chamber, but also provide sustained mixing throughout the cycle due to the faster recovery of the injectors. This effect leads to stronger detonation waves that could be the precursor for wave splitting. Analyses of the near-wave species distribution and the mixing process are presented.