Hypergolic rotating detonation rocket propulsion with low pressure-loss injection and advanced thermal management

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Research Objectives

- Advance SOA for enhanced pre-mixing, low-pressure-loss, minimized backflow and injection refresh, and thermal management enabled by novel RDRE injection design
- Starting TRL: 1—Little modeling or experiments for liquid space-storable hypergolic propellants in detonation-engines
- Ending TRL: 3—Modeled, built, tested hypergolic RDRE with parametric injector analysis at end of project

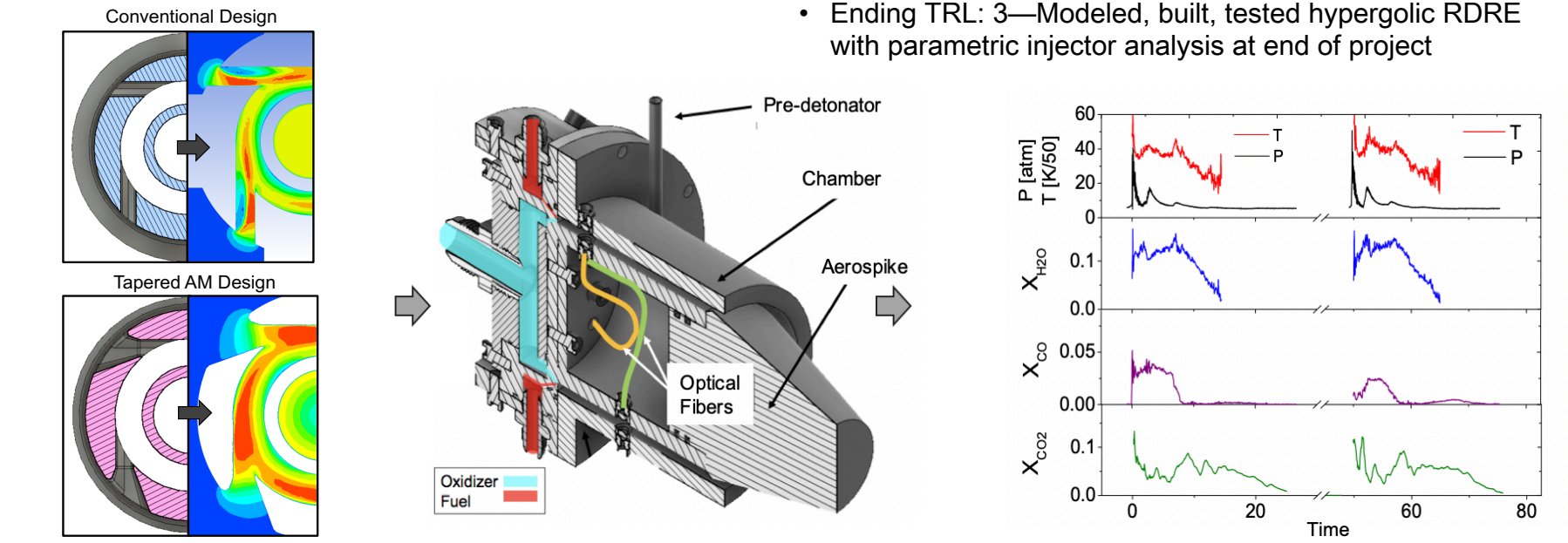

Figure: CFD-driven design process for coaxial injection, modular RDRE integration, and advanced instrumentation for hot-fire tests

Approach

- Coupled computational and experimental approach focused on multi-variable optimization for liquid-liquid RDREs
- Address technology limiting challenges of propellant pre-mixing, chamber wall cooling, and injection pressure loss
- Focus on space-storable propellants with hypergolic ignition
- CFD-driven injection designs enabled by additive manufacturing

Potential Impact

- Increased in-space chemical propulsion specific impulse
- Reductions in thruster system dry-mass
- Extended NASA mission durations
- Expedient path to technical readiness for advanced pulse-mode in-space chemical propulsion for NASA missions