Project Perseus

Development, Manufacturing, and Testing of the World's First Student-Built Rotating Detonation Engine (RDE)

Student

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Introduction: Project Perseus is an APL project at ARIS, initiated by a trio of collaborators: Thomas Ebnöther (OST), Simon Wespi (ETH), and Noah Giger (ETH). The project began in June with the ambitious goal to develop, manufacture, and test a Rotating Detonation Engine (RDE) by the end of December. This project builds upon the theoretical foundation laid by Thomas Ebnöther's bachelor's thesis on RDE technology. Project Perseus aims to experimentally verify these findings, providing a foundation for future technological development in Switzerland, where currently, no significant research on RDEs is being conducted.

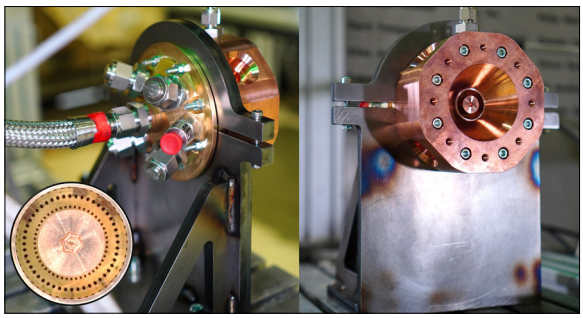
Approach: The project faced tight deadlines, including a Preliminary Design Review (PDR) in early July and a Critical Design Review (CDR) in August, with testing planned from September to December. To handle this workload, a team of 11 students from ETH and EPFL was formed and divided into specialized sub-teams:
Engine Team: Focused on developing the engine and ignition system, led by Thomas Ebnöther.
PSS Team: Worked on the hardware for the test bench, led by Matias Betschen.
DACS Team: Dedicated to testing systems and data collection, led by Noah Giger.
Management Team: Managed external relations and project sponsorship, led by Noah Giger.
To meet the strict timeline, the team adopted a 25.4 mm template engine using a methane/oxygen gas mixture, reducing risks and development time. Additionally, a pre-detonator using a hydrogen/oxygen gas mixture was designed for engine ignition. Dynamic pressure sensors from Kistler, with a sampling rate of 3 MHz, were employed to measure and verify the supersonic (> 1000 m/s) combustion within the RDE.
Following the CDR, the engine was manufactured at OST and subsequently integrated. Subsystem testing began in September with leakage tests, followed by ignition tests, and concluded with full engine firings conducted in November and December.

Result: The engine was successfully fired, achieving multiple combustion modes: deflagration, a counter-rotating detonation wave, and a single detonation wave. These modes were verified using dynamic pressure sensors in the combustion chamber, and the collected data aligned with documented RDE testing results. Furthermore, an aerospike nozzle was tested successfully, with the engine generating thrust exceeding 200 N.

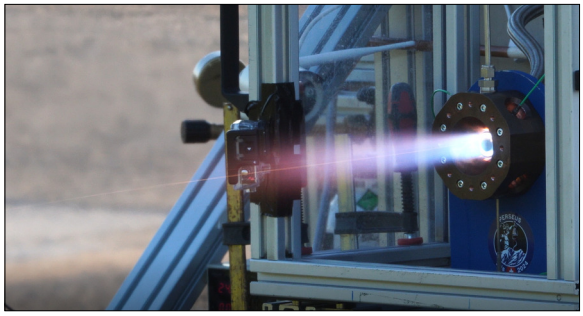
This project establishes a solid foundation for further RDE technology development at OST and ARIS. Planned next steps include bachelor's theses in Spring 2025 and a focus project at ETH, which aims to design and test a new engine with the long-term goal of achieving flight readiness. This progress represents a significant step forward in innovation at OST and ARIS.

Founding Trio on the ARIS Test Bench with Perseus Project Logo
Own presentment

Manufactured and Mounted Perseus RDE on the Test Bench, Highlighting the Combustion Chamber
Own presentment



Perseus RDE during Firing in a Detonative Combustion Mode
Own presentment



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Subject Area
Mechanical Engineering