

Master/Bachelor/Semester's Thesis

Topic: Design of Shear-Coaxial Rocket Engine Injectors for Combustion of Liquid Oxygen with Methane and Propane

Description

At the Chair of Space Propulsion and Mobility injection systems are investigated which shall address the needs of future flexible and robust rocket engines. Due to its combustion-defining character and the coupling thereof to the feed system, the injection system is central for these rocket engines: It must ensure fast mixing, sustained and stable combustion, while also limiting thermal loads. In addition, complexity reductions and ease of manufacturing are sought to reduce costs. Future rocket engine injectors must comply with all these requirements.

In the scope of this thesis, a shear-coaxial injector is designed for the injection of liquid oxygen (LOX) and gaseous and liquid methane or propane ($\text{GCH}_4/\text{LCH}_4$, $\text{GC}_3\text{H}_8/\text{LC}_3\text{H}_8$). This requires a design procedure that considers the physical processes of injection and combustion for different operating regimes. In order to apply the procedure to different engine thrust classes, the design must be scalable. Hence, the design procedure shall be implemented into a Python design toolbox. Based on this, a detailed CAD-design of the single-element injector is created which is then manufactured for experimental investigation. This single-element design is extended to a complete injector head design for a 500N-thrust-class research engine.

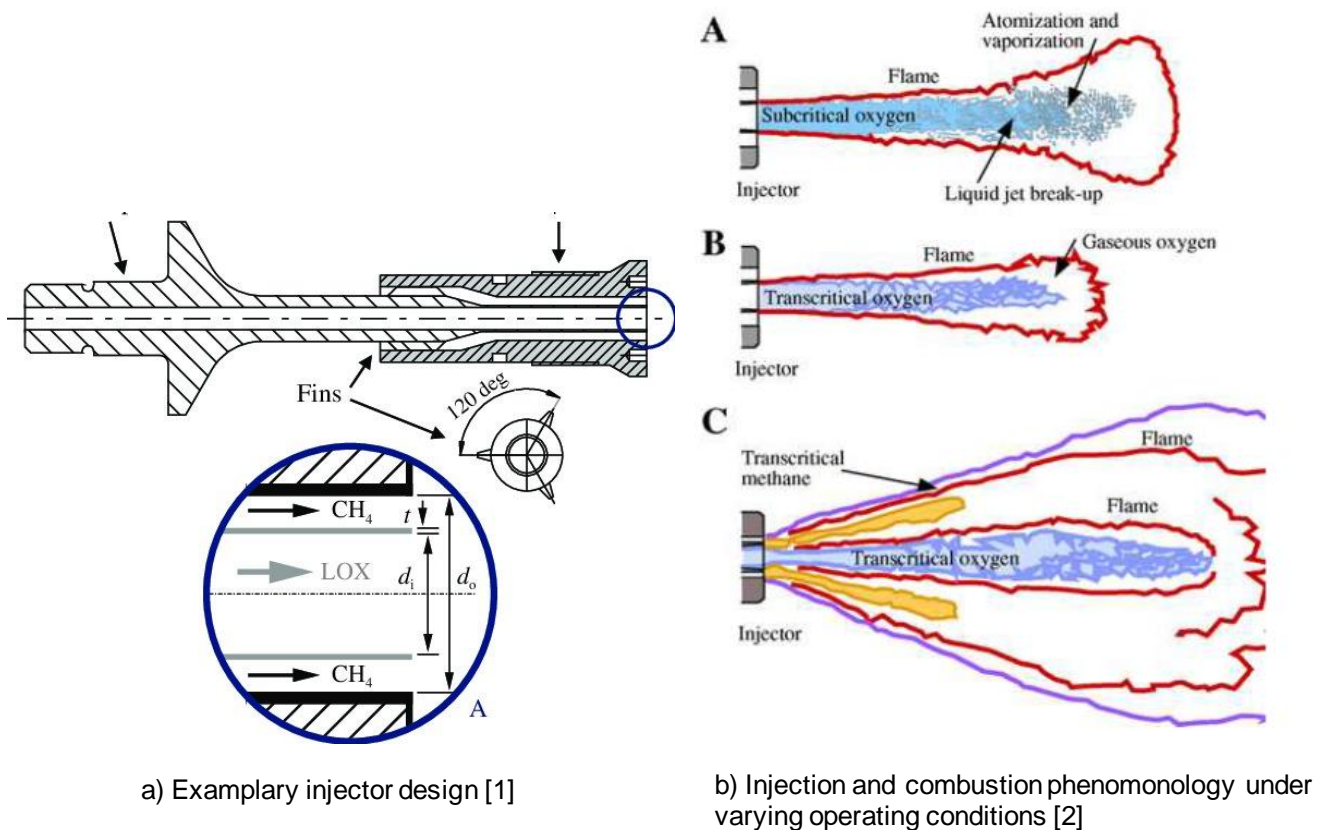


Figure 1: Shear-coaxial injection

[1] Lux, Johannes & Haidn, Oskar. (2009). Flame Stabilization in High-Pressure Liquid Oxygen/Methane Rocket Engine Combustion. *Journal of Propulsion and Power*. Vol. 25. 10.2514/1.36852.

[2] Singla, Ghislain & Scoufflaire, Philippe & Rolon, C. & Candel, Sebastien. (2005). Transcritical oxygen/transcritical or supercritical methane combustion. *Proceedings of the Combustion Institute*. 30. 2921-2928. 10.1016/j.proci.2004.08.063.

Your Tasks

- Review of existing shear-coaxial injectors, underlying atomization physics and design guidelines
- Development of a preliminary design procedure for shear-coaxial injectors
- Implementation of design procedure into a Python design toolbox
- CAD-design of a shear-coaxial injector and injector head assembly

Your Profile

- Mechanical Engineering, Aerospace Engineering or MSE Student
- Independent working attitude
- Team player
- Previous experience in CAD design is advantageous

We offer

- An amazing team that you can work with
- A large network of people
- Challenging exchanges with peers
- The possibility of getting involved into something big