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### Title

## Development of an injector sizing tool for a 4kN LOX/Ethanol student-built liquid rocket engine

### Authors

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### Abstract

PERSEUS is a European project led by students and operated by CNES, the French space agency. The aim is to allow students to engage in space related activities and gain valuable experience that will train them prior to beginning their professional activities in this sector. In this context, the Supaero Space Section technical club of ISAE SUPAERO is involved in the design of the next generation LOX/Ethanol liquid rocket engine MINERVA to be used in the sounding rocket ASTREOS 2 under development.

Burning of the injector plate, large pressure losses and lower than expected combustion efficiencies are the result of the currently used under-performing injector. It is therefore the objective of this research to provide a tool for predicting the performance of impinging and coaxial injectors, leading to a direct geometrical sizing usable for design. The tool is built on a database of experimental and theoretical correlations available in the literature for the design of liquid rocket engines injectors. They relate the injector element geometries and propellant properties to the injection pressure losses, liquid droplet size and mixing efficiency. Some of the key literature used in this research has been cited [1,2]. The triplet impinging injector, bi-swirl and shear coaxial injectors were considered and the capability of the tool has been demonstrated and applied to provide an optimal geometry for each under the expected operating conditions of the MINERVA engine. Limits on the injector design geometry are mostly impacted by the tolerances imposed with the selected manufacturing method. This tool shall be a building block of this injector design project, aiming to design and manufacture an injection system comprised of the injector plate and respective oxidizer and fuel domes.

### References

[1] A. H. Lefebvre, V. G. McDonell. 2017. Atomization and Sprays. Second Edition.

[2] V. G. Bazarov, V. Yang, P. Puri. 2004. Design and Dynamics of Jet and Swirl Injectors. American Institute of Aeronautics and Astronautics. Vol 200, pp 19-103.