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# BOREAS LIQUID PROPULSION ROCKET ENGINE PLATFORM: RECENT ADVANCEMENT IN MODELLING AND TESTING ACTIVITIES

**Abstract**

The need of innovation in liquid propulsion rocket technologies related to the introduction of the reusability in the nominal engine lifecycle, pushed CNES and ArianeGROUP to start the BOREAS (Bench Optimized for Research and tEchnology mAturation at Subscale) programme. The main purpose of BOREAS is to dispose of a subscale technological platform that allows developing and testing most of the technological building blocks needed for the design of the new generation liquid propulsion rocket engines such as additive layer manufacturing, engine electrification, deep throttling, autonomous engine health monitoring system, cost reduction, to name some. The current configuration of the platform consists in a LOx/LH2 expander bleed cycle engine of 10 kN thrust. The aim of this paper is to describe the recent advancements in sub-components and engine testing as well as system modelling activities. Thrust chamber test results allowed the characterization of ignition stability, combustion roughness, thermodynamic behaviour of the combustion chamber and nozzle extension as well as the dynamic stability of the system to transient conditions (in presence of an altitude simulator). The characterization of hydrogen pump and turbine performances, rotor dynamics behaviour and axial balancing system tuning has been performed during turbopump test campaign. These main results were used to tune the engine dynamic system model, previously developed according to preliminary design of the engine sub-components, and to make adjustments w.r.t. important phenomena leading to shift in the engine performances (as turbopumps performances, regenerative circuit thermodynamic behaviour, flow-separation in the nozzle when the altitude simulator is not activated, ..). The engine system model has been finally used to generate engine hot-firing test forecast and test bench preparation (hot firing tests are foreseen on second semester of 2022).