Development of a Supersonic Research Rocket with Hybrid Rocket Engine

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As participant in the STERN program of the German Aerospace Center (DLR), the ExperimentalRaumfahrt-InteressenGemeinschaft e.V. (ERIG) is developing a research rocket which will reach a velocity of at least Ma=1.5 and an altitude higher than 11 kilometers. The designated propulsion system is a hybrid rocket engine with nitrous oxide (N_2O) as liquid oxidizer and hydroxyl-terminated polybutadiene (HTPB) with metallic additives as solid fuel grain. The anticipated engine specifications are a thrust of 5000 N and a total impulse of 75000 Ns.

The paper presents former achievements of the ERIG in the field of self-developed telemetry, sensor systems and microprocessor programming, structural design and launching of amateur rockets. Furthermore, the latest developments and test results of the hybrid rocket engine HYDRA-3X (HYbridDemonstrations-RaketenAntrieb) are described.

Based on this knowledge, a more powerful engine HELIOS and a preliminary concept for the prospective rocket REGULUS have been designed. For HELIOS, a new test plant and a measurement system have been constructed and will be mounted at the DLR test facility in Trauen, Germany. The measurement system has a nominal sampling rate of 1 kHz and a port for a high frequency pressure sensor with a sampling rate of 20 kHz.

In order to predict the trajectory, performance and stability of the rocket, a flight simulation based on MATLAB/Simulink is being developed. The validation of this program will be done by measurements and computational fluid dynamics simulations.