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MHD thrust vectoring of a rocket engine. JULIEN LABAUNE, DENIS PACKAN, FABIEN THOLIN, LAURENT CHEMARTIN, ONERA, THIERRY STILLACE, FREDERIC MASSON, CNES Launcher Directorate — In this work, the possibility to use MagnetoHydroDynamics (MHD) to vectorize the thrust of a solid propellant rocket engine exhaust is investigated. Using a magnetic field for vectoring offers a mass gain and a reusability advantage compared to standard gimbaled, elastomer-joint systems. Analytical and numerical models were used to evaluate the flow deviation with a 1 Tesla magnetic field inside the nozzle. The fluid flow in the resistive MHD approximation is calculated using the KRONOS code from ONERA, coupling the hypersonic CFD platform CEDRE and the electrical code SATURNE from EDF. A critical parameter of these simulations is the electrical conductivity, which was evaluated using a set of equilibrium calculations with 25 species. Two models were used: local thermodynamic equilibrium and frozen flow. In both cases, chlorine captures a large fraction of free electrons, limiting the electrical conductivity to a value inadequate for thrust vectoring applications. However, when using chlorine-free propergols with 1% in mass of alkali, an MHD thrust vectoring of several degrees was obtained.

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