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TRANSIENT PROCESS SIMULATION OF 180KN LOX/KEROSENE UPPER STAGE ENGINE WITH ROCKETENGINE SOFTWARE VERSION 2.0

Abstract

System transient process simulation is critical for the performance analysis of liquid rocket engines and pre-design activities in particular. RocketEngine software is an important tool for modeling rocket engine systems at National Key Laboratory of Science and Technology on Liquid Propulsion Rocket Engine, CASC. RocketEngine is an object-oriented visual simulation platform capable of modeling various kinds of dynamic systems represented by deferential-algebraic equations (DAE) or ordinary-deferential equation (ODE) and discrete events. The modeling of physical components is based on the Modelica language, an object-oriented programming language powerful enough to model continuous and discrete process. It provides a modular and general framework for simulating the steady-state and transient behavior of any desired propulsion system.

In this work, RocketEngine software is updated to version 2.0 that employs 6 libraries containing various types of components (include liquid pipe library, gas pipe library, valves library, combustion chambers library and turbomachinery library). RocketEngine can be used to model several engine cycle systems such as gas generate cycle, staged combustion cycle, pressure-fed cycle etc.

The transient phase of the 180kN LOX/Kerosene Upper Stage Engine has been taken as validation case. Comparison with test data shows that the model and the software are effective and versatile. The start-up and shutdown procedure of the engine including under flight condition are simulated using the simulation software mentioned above. The influence factor on start-up process such as solid propellant starter characteristics, starting sequence, tanks pressure, and mass flow rate of flow regulator are incestigeted. The influence factors on shutdown process such as injection gas pressure, volume of fuel valve downstream, shutdown condition, valve response time are investigated too.