

High-fidelity Modelling of Self-regulating Pneumatic Valves

Alexander Pollok¹ Francesco Casella²

¹Institute of System Dynamics and Control, German Aerospace Center (DLR), Germany, alexander.pollokdlr.de

²Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Italy, francesco.casella@polimi.it

In conventional aircraft energy systems, self-regulating pneumatic valves (SRPVs) are used to control the pressure and mass flow of the bleed air. The dynamic behavior of these valves is complex and dependent on several physical phenomena. In some cases, limit cycles can occur, deteriorating performance.

This paper presents a complex multiphysical model of SRPVs implemented in Modelica. First, the working-principle is explained, and common challenges in control-system design-problems related to these valves are illustrated. Then, a Modelica-model is presented in detail, taking into account several physical domains. It is shown, how limit cycle oscillations occurring in aircraft energy systems can be represented with this model. Finally, some multi-domain interactive effects are described.

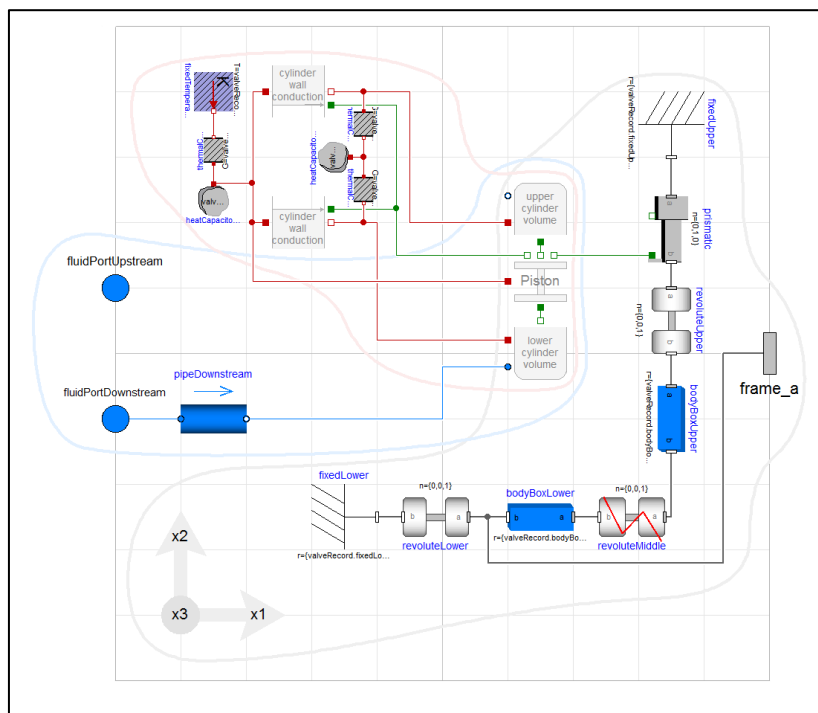


Figure 1. Modelica component layer of the valve-actuator base model