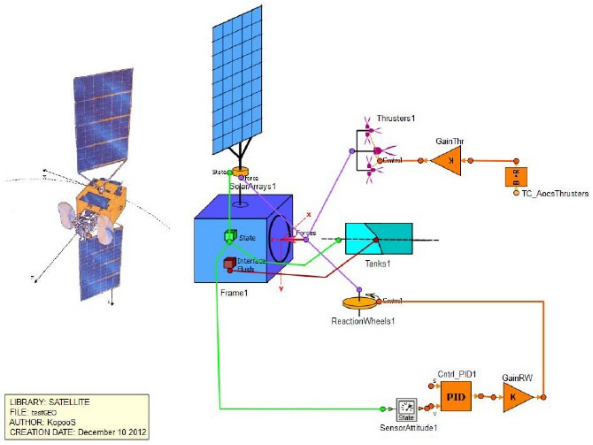
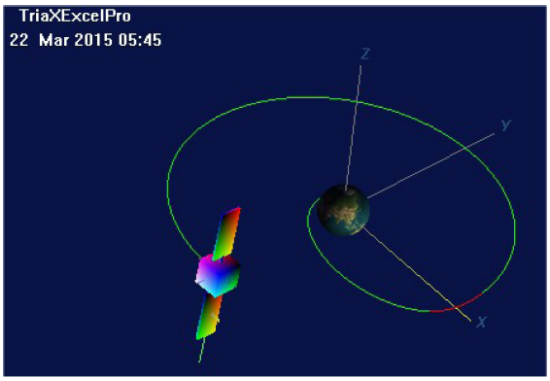
The AOCS' effects on the Propulsion Subsystem using the ESPSS Satellite Library

Christophe Koppel[(1)], Marco de Rosa[(2)], Fernando Rodríguez Lucas[(3)], Dr. Johan Steelant[(4)]

[(1)] KopooS Consulting Ind., 57 rue d'Amsterdam 75008 Paris, France, Christophe.Koppel@kopoos.com
[(2)] ESTEC , Keplerlaan 1, P.O. Box 299, 2200 AG Noordwijk, The Netherlands, Marco.De.Rosa@esa.int
[(3)] Empresarios Agrupados, c/Magallanes 3, 28015 Madrid, Spain, frl@empre.es
[(4)] ESTEC , Keplerlaan 1, P.O. Box 299, 2200 AG Noordwijk, The Netherlands , Johan.Steelant@esa.int

The paper documents the phase 3 of the work performed for the implementation and validation of a satellite platform propulsion system modelling library ESPSS (European Space Propulsion System Simulation) within the existing tool EcosimPro®.
EcosimPro® is a Physical Simulation Modelling tool that is an object-oriented visual simulation tool capable of solving various kinds of dynamic systems represented by writing equations and discrete events. It can be used to study both transients and steady states. The object oriented tool, with the propulsion library ESPSS for example, allows the user to draw (and to design at the same time) the propulsion system with components of that specific library with tanks, lines, orifices, thrusters, tees. The user enhances the design with components from the thermal library (heaters, thermal conductance, radiators), from the control library (analogue/digital devices), from the electrical library, etc.





The paper will present several new components added to the propulsion library as well as some example. Those improvements have been performed in the phase 3 of the development of ESPSS consisting of updating and extending multiple libraries to represent a functional propulsion system, e.g. fluid properties, pipe networking including multi-phase fluid flow, two-phase two fluids tanks with gravity or accelerations effects, non-adiabatic combustion chambers, chemistry, turbo-machinery, etc.
The paper presents the modelling of propulsion system performed in order to check the implementation of the new components especially the components dealing with the effects of the mission on the propulsion sub-system. In particular, the accelerations generated by thrusters, reaction wheels and other satellite components have an influence on the fluid-dynamic behaviour of the propulsion system. Moreover, the propellant tanks fill level influences the satellite's center of gravity and moments of inertia, which can in turn have an effect on the pressure and flow conditions in fluid lines. The use of the ESPSS satellite library for being able to model some interactions between the AOCS and the propulsion system will be presented. A full satellite missions, for example an orbit transfer from GTO to GEO will be presented and particular behaviors highlighted.

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