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NOVEL V&V APPROACH AT PIL LEVEL IN OPEN LOOP CONFIGURATION FOR NONLINEAR ONLINE OPTIMIZATION PARAFOIL GUIDANCE OF REUSABLE SPACE VEHICLES

Abstract

The current paper focuses on the PIL test campaign performed to validate descend and landing technologies developed by Deimos Space Romania in the framework of the REVLANGNC project under an ESA contract. Several activities have been performed in the last few years, specific to different steps of the research process. A complete GNC solution has been tailored and tested for the DL GNC system to be used in a parafoil architecture.

The validation campaign at PIL level has been challenging since PIL campaign has been focused exclusively on open loop configuration. The standard validation approach at PIL level could not be applied for Nonlinear online optimization Parafoil Guidance due to the nature of the algorithm. A novel verification and validation approach has been applied to successfully complete the PIL campaign and advance to the next testing campaign which is the delta-qualification of the HW/SW co-design on both on-ground and in-flight level. This VV approach uses specific optimization indicators monitoring and SIL closed loop simulation results in order to directly analyze specific Parafoil Guidance signals behavior as well as their numerical accuracy. One major advantage of this VV approach is that it is applicable to all algorithms designed and implemented in a similar manner to the Nonlinear online optimization Parafoil Guidance.

The GNC performance has been validated in a representative configuration for space applications at PIL level to reach TRL 5/6. Additional delta-qualification testing has been performed in a partially representative configuration to demonstrate the capabilities of the newly tailored Nonlinear online optimization Parafoil Guidance algorithm during actual drop tests under parafoil.

Results obtained thus far are very promising and encourage continuing the research to consolidate the current VV approach and further develop the technology up to TRL 6/7 in a fully representative configuration, together with an increased payload and touchdown landing accuracy.