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TESTING OF INTER-SATELLITE COMMUNICATION FOR FORMATIONS OF SMALL  
SATELLITES

**Abstract**

Ground testing of crosslinks for multi-satellite missions is an important aspect of satellite qualification. Traditionally, individual satellites are rigorously tested on ground in order to ensure impeccable operation in space. With the “New Space” development toward smaller satellites in higher numbers, the challenge now is to define innovative testing procedures that cover new operational aspects, such as inter-satellite communication between multiple satellites. In the course of the NetSat mission, an ISL (inter-satellite link) testbed has been developed and operated in order to demonstrate the inter-connection of all four satellites of the formation using UHF radio signals. With this testbed, various formation topologies can be replicated and evaluated with respect to ISL performance. The testbed uses aluminum satellite bodies, which retain the dimensions and the RF reflectiveness of the flight models. Additionally, the internal communication chain is identical to the flight models, both in hardware and in software, starting from the on-board computer (OBC) to the radios and ultimately to the antennas, including the antenna deployment mechanism. With the help of non-reflective tripods and selected signal attenuators, the required separation of the satellites is replicated with sufficient precision. In order to reproduce a polarization mismatch of the dipole antennas caused by spinning satellites in orbit, the ISL models are able to rotate around all three axes on the tripods. The ISL testbed is currently being employed for fine tuning of the NetSat communication parameters, such as radio output power, modulation, and coding. However, it has also proven helpful in redefining mission parameters, such as using attitude control for optimizing signal strength, as well as formation parameters, such as maximum satellite separation. After the launch of the NetSat formation in the summer of 2020, this testbed will still be used for experiment verifications and error replications. In the future this testbed will also be extended for upcoming missions that use patch antennas for directional communication between multiple satellites.