Key Technologies (7)
Structures Modeling, Designing, and Testing (1)

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SMALL PROBES FOR DEEP SPACE EXPLORATION

Abstract

French involvement in affordable deep space missions has been illustrated over the last few years by the accomplishments of the Philae lander in 2014, and by the mission of the Mascot lander, developed with DLR, which was dropped in October 2018 by JAXA's Hayabusa 2 probe on asteroid Ryugu. It will be put into practice again through our contribution to JAXA's MMX mission to Phobos in 2024, and more mission concepts are also being defined in partnership with major Space Agencies.

In the cases above, cubesats or small lander / rovers depend on a larger spacecraft for deployment and other resources, such as telecommunication relay or propulsion. Under other circumstances, teams of cubesats can also be deployed and perform advanced tasks such as telecommunication relay or distributed scientific measurements. This may involve surface networks, constellations of orbiters, or a combination of both. Small rovers or drones could also in the future represent valuable assets in support to human activities at the surface of the Moon or Mars.

This presentation will elaborate on mission architectures for the most promising concepts that CNES has studied or been associated to where small probes (from cubesat class to 200 kg) offer an advantage in terms of affordability, efficiency, and capacity to take risks. In some cases, typically between Venus and Mars, we will see that small probes can operate as stand-alone missions of their own within the inner solar system. Alternatively, they can also augment larger missions to the most remote and challenging destinations in the solar system. The critical technologies for each type of architecture will be identified.

While microsatellites are affordable, and increasingly more capable, they should not be considered as a replacement for more traditional missions that require multiple coordinated measurements to accomplish their science investigation goal. Additionally, larger spacecraft remain far more powerful and can go to more remote locations, survive longer duration missions and challenging deep space environments. Under many circumstances, however, large spacecraft can benefit greatly from the risk capacity provided by small probes that can be added on, and from the multipoint capacity that they can provide. In this respect, the combination of small probes with larger infrastructures will ultimately make it possible to reach further into the solar system and explore new destinations in depth.