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Insights gained from Data Measured by the CONSERT Instrument during Philae's Descent onto 67P/C-G's surface

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The scientific objective of the Comet Nucleus Sounding Experiment by Radiowave Transmission (CONSERT) aboard ESA spacecraft Rosetta is to perform a dielectric characterization of comet 67P/Chuyurmov-Gerasimenko's nucleus. This is done by means of a bi-static sounding between the lander Philae launched onto the comet's surface and the orbiter Rosetta. For the sounding, the CONSERT unit aboard the lander will receive and process the radio signal emitted by the orbiter counterpart of the instrument. It will then retransmit a signal back to the orbiter to be received by CONSERT. This happens at the milliseconds time scale.

During the descent of lander Philae onto the comet's surface, CONSERT was operated as a bi-static RADAR. A single measurement of the obtained data is composed of the dominant signal from the direct line-of-sight propagation path between lander and orbiter as well as paths from the lander's signal being reflected by the comet's surface.

From peak power measurements of the dominant direct path during the descent, the knowledge of the orbiter and lander positions and simulations of CONSERT's orbiter and lander antenna characteristics as well as polarization properties, we were able to reconstruct the lander's attitude and estimate the spin rate of the lander along the descent trajectory. Additionally, certain operations and manoeuvres of orbiter and lander, e.g. the deployment of the lander legs and CONSERT antennas or the orbiter change of attitude in order to orient the science towards the assumed lander position, are also visible in the data.

The information gained on the landers attitude is used in the reconstruction of the dielectric properties of 67P/C-G's surface and near subsurface (metric to decametric scale) and will hopefully prove helpful supporting the data interpretation of other instruments.

In the CONSERT measurements, the comet's surface is visible during roughly the last third of the descent enabling a mean permittivity estimation of the surface and near subsurface covered by the instruments footprint along the descent path. The comparatively large timespan with surface signatures exhibits a spatial diversity necessary for the mapping of dominant signatures and the estimation of the dielectric properties of prominent features yielding a possible contrast and permittivity mapping of the comet's surface in the vicinity of the original landing site.