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A Moon-based Sensors Network supporting Science and Navigation

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The Moon is currently a prime focus of space exploration. The spacefaring nations are studying, defining and implementing a series of robotic orbital and landed missions to the Earth's natural satellite. Looking beyond the lunar robotic missions to be flown by 2008 by the international community, goals to be accomplished by future (robotic) missions will include a broad range of Moon science (e.g. early Earth-Moon system, terrestrial planet differentiation and evolution, solar system impact record, lunar environment) as well as a demonstration of key technologies for later robotic and human activities on the Moon (e.g. high-precision landing). Combining these goals calls for identifying and developing concepts related to optimal implementation of science within an advanced technology and instrumentation suite.

One possible approach, being well-suited to serve diverse science opportunities as well as technology demonstration, would be the deployment of a multi-sensors network supporting science and navigation on the lunar surface. On the science side, such a network could include classical network instrumentation: geophysics instruments, e.g. seismic and heat flow instrumentation and environmental sensors.

A geodesy suite (i.e. a combined laser ranging and radio VLBI package with new-generation retroreflectors and laser transponders/beacons) would complement the science suite. In addition to the science purpose, e.g. high-precision ranging at millimeter level, tracking of lunar librations and discerning key lunar interior properties, this part of the network would furthermore be capable of serving technological purposes, namely non-vision navigational/surveying techniques for planetary lander navigation,

as currently being exploited by the Space Autonomy Group at Surrey Space Centre. In this context, pre-landed beacon pseudolite (pseudo satellite) network(s) could be used to achieve high precision landing of a spacecraft. Such networks based on the concept of a terrain based GPS system are capable of achieving accuracies on Earth to +/-10 mm over an area of some 10 km. Deploying the beacons at a permanent base on another planet would allow base modules to be landed next to each other, avoiding the need for any traction system within each module and thus providing greater working volume within each module landed. A cost analysis of landing fewer modules against the up-front cost of pre-landing the pseudolite network and maintaining the system for the full mission extent will be undertaken. The sensor networks would have the advantages of operating continuously (mandatory for the scientific purpose) over any period of time and providing, in addition to the construction phases, the ability to deliver all locational services required by ground agents, surface rovers, sampling rigs, etc. within the defined project area to a high degree of precision and accuracy.