Geophysical Research Abstracts, Vol. 7, 06189, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06189

Seismometer network configurations optimized for the observed fault distribution on Mars

M. Knapmeyer, J. Oberst and T. Spohn
Institute of Planetary Research, German Aerospace Center DLR (martin.knapmeyer@dlr.de)

By providing a direct view into the interior of the planet, a seismological network on Mars would be of utmost importance for the further restriction of geodynamical modelling.

A seismic network needs to be optimized with respect to detection and location of the expected quakes. At the same time, technical restrictions concerning possible landing sites and long term station survival have to be considered. We present the results of an automated optimization process, which takes all these constraints into account and returns a number of different feasible network configurations.

To estimate the likely geographical distribution of marsquakes, we use the fault inventory recently derived at DLR from the MOLA 1km digital terrain model. This inventory contains 3642 thrust faults and 3746 normal faults with lengths from 8km to 1445km and is representative for faults longer than 50km. A fault-length-magnitude relation derived by Wells & Coppersmith (1994) for faults on earth is used to estimate the magnitude of the largest quake each of the faults can produce. Using the magnitude-frequency relation derived by Philips (1991) from the expected thermal contraction rate, it is then possible to generate a hypothetical seismic event catalogue which incorporates observed tectonical features as well as a physically reasonable Gutenberg-Richter relation. As additonal engineering constraints, we assume that station survival would be possible only at latitudes below 30 degrees for reasons of lander heating capacity. Additionally, a parachute landing is assumed that requires the landing sites to be below an altitude of 0m (as defined by the MOLA DTM). These constraints define a map of allowed landing sites.

A niching genetic algorithm is then used to optimize the network configuration with respect to the hypothetical quake catalogue and the allowed sites. Stations should be as

close as possible to the epicenters to optimize the detection rate, and they should also be distributed in a way that allows to locate the epicenters using seismic data. A widely used proxy to assess the location capability of a seismic network is the azimuthal gap, which is defined as the largest azimuth angle, measured at the epicenter, in which no station is situated. Azimuthal gap and distance to the nearest station are used as measure for network quality. The genetic algorithm allows for the implementation of additional criteria which may arise from constraints of other experiments onboard the landers.

The optimization process results in a number of configurations, which share station locations in relatively small areas. Each configuration satisfies predefined quality criteria in terms of detection and location capability. The set of resulting network configurations may then serve as a basis for further considerations, like choice of the geologically most interesting target.