TOPOGRAPHIC MAPPING OF VENUSIAN CRATERS USING ARTIFICIAL NEURAL NETWORKS. T. Bond, *Department of Earth Science and Engineering, Imperial College, Prince Consort Road, London SW7 2BP, UK (timothy.bond@ic.ac.uk).*

SAR data available from NASA's Magellan mission gives high resolution RADAR images of the Venusian surface in three cycles of data coverage. In the absence of direct measurements or global high-resolution altimetry the use of stereo pairs of SAR data allows topographic maps of the Venusian surface to be generated. Of particular interest to this work is the generation of topographic maps of impact craters.

Areas with data coverage from both cycle one and cycle three Magellan passes are suitable candidates for stereo-pair mapping. Due to mission operational difficulties some areas of the planetary surface only have data coverage from either cycle one or cycle three ruling out the generation of topographic maps from a measured stereo-pair. In these areas alternative approaches must be taken to produce a topographic analysis of surface features.

Previous work has used methods such as shape-by-shading to generate a topographic map; this work attempts to use artificial neural networks to generate a synthetic stereo-pair dataset. It is hypothesized that given a regional datum there are specific data patterns arising from surface features which identify the topographic expression of the surface. If this correspondence is a valid one, an artificial neural network may be able to be trained with the known stereo-pair SAR data to synthesize a second SAR look for a crater with only a single measured SAR look.

During training, a feed-forward network is presented with linear sections of data from one look angle and uses a back-propagation algorithm to learn the correspondence between this input data and a linear section of output data that is extracted from a subset of the input geographical locations. Of necessity both linear sections are taken along the SAR look direction such that parallax difference resulting from topography above or below the datum is colinear with the data. Preprocessing of the F-MIDR dataset ensures that the artificial neural network's input and output cover the same geographical locations.

Careful consideration of input data is necessary to ensure that the computational time does not increase beyond reasonable operational limits but also that enough context is given to the artificial neural network that it can accurately identify the surface features under observation. Initial considerations included passing off-line data alongside the linear data to supply some regional context, either in the form of unmodified F-MIDR information or through extracted representative parameters. For the latter case, two-dimensional Fourier transforms and discrete cosine transforms were considered, as were image compression methods.

Error analysis is performed in two ways. The first method calculates the sum squared errors between a generated synthetic SAR look and a verification dataset from measured Venusian stereo-pair information. A second method calculates the error between a topographic map generated using a measured stereo-pair and a topographic map generated from a single measured SAR look and the corresponding synthetic stereo look. An acceptable error would be comparable to or better than that resulting from other single-look topographic analysis methods.

That such methods as shape-by-shading provide reasonable topographic maps from a single look suggests that one SAR image contains sufficient detail to enable a neural network to extract pertinent information. It is a matter of present debate whether this information is altitude-specific or whether it encodes gradients from which altitude can be calculated. If the latter, it may be a requirement that any input dataset used for network training contains some reference to the local datum.

Preliminary results expected by March 2003 should provide a first indication of the success or limitations of the network and examine network design and training specifically relating to the interpretation of impact crater topography.