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Exploration of Mars (08)
Robotic Mars Exploration (1)

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SNIFFING AS A STRATEGY FOR DETECTING LIFE ON MARS

Abstract

Scent-following is a well established biological search strategy which may be applied to the search for life on Mars. Detection of atmospheric methane on Mars reveals a planet which is more intriguing than previously thought. If the source of the methane is found to be biotic in nature, it would be the first evidence that life exists or existed on Mars. This would be an exciting revelation, but the spatial resolution of these methane detections have been on the order of kilometres. This does not sufficiently constrain the source of the plume, the scientific point of interest. We propose a surface exploration system that localizes the source of the plume during the traverse phase of a rover mission. The sensor suite includes a methane detector which gives the concentration. A wind detector gives the mean wind vector and is utilized to predict the forcing function acting on the methane gas in the target area. Due to the turbulent nature of the winds, a gradient following technique is not appropriate. We propose a novel approach to this problem which combines the plume-localization problem with a control capability by using neural fields to give the rover its instantaneous trajectory. Neural fields have similarities to potential fields which are used in robotic navigation. The response of the neural field to a given input is dependent upon the activation functions of each neuron and the interaction function which describes the connection between neurons in the field. A Kalman Filter learning rule is employed to train this network on line in response to the changing environment. Since the Kalman filter incorporates both sensory information in addition to a model of the environment it is able perform beyond the capabilities of the traditional back-propagation and Hebbian-type learning methods.