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Bio-Nano-Machines for Space Applications

This project aims at proposing, studying and evaluating novel concepts of space devices that are based on revolutionary bio-nano-mechanisms formed by protein and DNA based nano-components. The recent explosion of research in nanotechnology, combined with important discoveries in molecular biology have created a new interest in biomolecular machines and robots. The main goal in the field of biomolecular machines is to use various biological elements — whose function at the cellular level creates motion, force or a signal — as machine components. These components perform their preprogrammed biological function in response to the specific physiochemical stimuli but in an artificial setting. In this way proteins and DNA could act as motors, mechanical joints, transmission elements, or sensors. If all these different components were assembled together in the proper proportion and orientation they would form nanodevices with multiple degrees of freedom, able to apply forces and manipulate objects in the nanoscale world. The advantage of using nature's machine components is that they are highly efficient and reliable. We will identify and study computationally and experimentally protein and DNA configurations that can be used as bio-nano-machine components. We will then study the design of two macro-scale devices with important space application that will be using bio-nano-component assemblies. The *Networked TerraXplorer* (NTXp) will be a long and light-weight network of channels containing millions of bionano-robotic elements with ultra-enhanced sensing and signaling capabilities. NTXp could be used to map and explore in detail very large planetary surfaces. The *All Terrain Astronaut Bio-Nano Gears*(ATB) will serve as an extra layer of shield on the astronaut providing early detection and protection against dangerous and harmful environments or aiding in healing damages caused to the astronaut. The ATB gear will consist of micro membranes and surface sheets that contain swarms of bio-nano robots providing sensing and signaling capabilities.

