Positioning capabilities of the Planetary Instrument for X-ray Lithochemistry

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The Planetary Instrument for X-ray Lithochemistry (PIXL) is a sub-mm focused beam X-ray fluorescence spectroscopy system developed for placement on the arm of the forthcoming Mars 2020 rover. The National Aeronautical and Space Administration will use PIXL to investigate Mars Jezero landing site petrology with specific emphasis on searching for bio-signatures and rock samples that merit caching as part of a future return mission. The PIXL instrument subsystems include a rhodium X-ray tube, nominally operated at 28 kV and 20 µA, coupled to an XOS polycapillary focusing optic, an optical fiduciary systems (OFS) used to gain position information and standoff correction, two Ketek H50 detectors and a mechanically driven hexapod micro-positioning system. The later systems allows for the PIXL sensor assembly (SA) to move and raster-scan to produce elemental line scans as a means to generate full elemental map datasets.

The hexapod positioning system is an in-house design that incorporates six struts of mechanically adjustable length. In utilizing OFS image information of the rock, in conjunction with on-board flight software, the hexapod system moves the SA to produce a commanded result, such as a straight-line scan X-ray raster scan. The complexity of the hexapod system is such that motor movement of all six struts, through a software driven computation, is required to produce even the simplest one-dimension translational movement. When considering its novel design and complexity, the development of a working hexapod system, represents a major achievement in the PIXL development process.

In this talk, I will provide an overview of the instrument subsystems including, the hexapod positioning system. The topics for discussion will include presentation of several obstacles anticipated during operation as well as PIXL’s integrated capabilities intended to overcome these challenges. Obstacles include correcting for environmental thermal variations that may shift the SA nominal position over the course of a long duration scan activity, maintaining a constant Z-axis standoff to the measured target in situations of variable rock topography and relocating the SA to previously imaged landmarks in order to co-register visual context images to elemental X-ray map data.