Handheld or Rover-mounted Compact Patterned Filter IR Imager for Rapid Geochemical Analysis. P.E. Clark[1], R. Glenn Sellar[1], Daniel W. Wilson[1] [1]Jet Propulsion Laboratory/California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109, pamela.e.clark@jpl.nasa.gov.

Purpose: We propose to use recent advances in instrumentation described below to equip the astronaut crew with very compact handheld or rover mountable visible/IR imagers, with the capability to instantaneously display the character of lunar terrain in the instrument's field of view (rock suite, mineralogy, surface volatiles). The use of color is intended to make variations in otherwise-subtle 'shades of gray' differences in the lunar landscape stand out to be much more readily interpretable by astronauts and ground crews in real time.

Enabling Advances in Instrumentation: A key technological frontier in multispectral imagers beyond the original Multispectral MicroImager concept [1] is now the patterned filter, which enables color infrared imagery at up to video rates. The prior state-of-art in patterned filters is the visible color "Bayer" filters used in commercial digital cameras, which are spectrally limited to available color dyes for blue, green, red and a limited number of colors. The extraordinary spatial resolution of e-beam lithography now available at JPL's Microdevices Laboratory (MDL) enables nanolithography techniques for fabricating spectral bandpass filters that can be patterned spatially on the scale of focal plane array (FPA) pixels. This enables the fabrication of video-rate cameras with spectral bandpasses (colors) that are customizable to any desired wavelengths (colors) over a wide spectral range from the visible through the short-wave infrared (SWIR).

Instrument Concept: The instrument is compact and simple in design: a camera lens with the specially designed patterned filter placed on the FPA of an infrared camera. A small battery pack (charging up between crew uses while attached to the powered rover) and WIFI device would be included. We propose to use an array of 4 to 9 filters with band-centers from 0.9 to 2.5 microns corresponding to absorption features associated with major minerals (pyroxenes, olivine, plagioclase), liquid water, hydroxyl, and water ice. The thermally-, mechanically-, and dust-protected packaged instrument would have a simple mechanical interface to allow it to be mounted on the rover, or detached and held by an astronaut to characterize objects or terrains of interest by panning around the surrounding 360 degrees. Data collected at a desirable frame rate would be transmitted to a convenient display, mounted in the rover or even on the astronaut's sleeve, glove or visor. Display would be in vivid, easily interpretable color, allowing rapid assessment of geochemical character and the presence of adsorbed or ice volatiles.

Instrument Requirements: current best estimates assuming daytime use are summarized below. Illumination options for shadowed areas can also be explored. This design will soon be updated to include the high performance thermal components now being developed and flight qualified at JPL, which could eliminate the need for thermoelectric coolers (TECs), and potentially reduce power and possible mass.

Mass: 1 kg
Power: 3 watts (in use)
Volume: ~1 U (~1 L)
Bandwidth: 4 MB/frame x frame rate

Crew Involvement and Operation: The features of this instrument that would make it most useful and easy to use for the crew (and thus potentially 'standard gear') include: a) fitting neatly in the gloved hand; b) easily detachable for mounting on a crewed rover, or on a robotic or astronaut-controlled rover; c) recharging by plugging into a powered vehicle or habitat; d) enabling rapid confirmation of the rock types and geologic association of a given site, as well as identification of the nature and relationships of soils and rocks of interest to terrain features around the site. The battery pack would be sized for estimated duration of crew 'off-rover' time of at least an hour.

References: [1] Nunez J., Farmer J., Sellar G., Allen C., 'Microscopic Imager: integrating microimaging with spectroscopy for the In-Situ Exploration of the Moon', LPS XLI , Abstract #1581, 2010.