How do we make rovers better geologists at Mars?

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As Mars exploration continues, we will rely on rovers to perform analyses in situ. The scientific return from such missions can be enhanced if routine observations relevant to geologic interpretation are performed with onboard computers. We attempt to identify measurements in realistic geologic environments that can allow a rover or team of rovers to recognize and classify data in terms of geologic importance and subsequently optimize collection and transmission of relevant data to Earth. We approach this problem in two main steps. Firstly, we develop recognition tools that use images and spectra collected by a rover to autonomously classify a scene. We have already developed algorithms that 1) classify rocks on the basis of texture, which is useful to separate rocks from soils, and 2) detect a specific or unique mineralogy from numerous spectra (Gilmore et al., JGR 105, 29223). A second step is to utilize these tools in a scenario where data is collected by a team of rovers. This data collection is performed autonomously through the use of an onboard planning tool that decides what exact rover actions are necessary to achieve the science goals (Estlin, et al., AAAI-99). As part of this step, data priorities are determined by the onboard data-analysis software and are then utilized by the planning tool to coordinate what measurements are taken. Science goals may include: the characterization of a geologic unit, the identification of geologic contacts, and the recognition of and search for unusual lithologies.