



Mars Moons Prospector Mission with CubeSats

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The preliminary design of a low-cost Discovery class mission for prospecting Mars moons Phobos and Deimos is undertaken as capstone senior design class in spacecraft design. The mission design is centred on a mothership that carries a dozen of 12U CubeSats, each of 22x22x34cm in size and 24kg in mass. The mothership is equipped with a set of instruments for the investigation of regolith samples, similar to those with identical functions on the Curiosity and the Mars 2020 rovers. The mothership also serves as a telecommunication hub with Earth. Six of the CubeSats have the role of touching down and picking up soil samples for delivery to the mothership for analysis and the six have the role of visually inspecting the moon at close proximity in visible and near and mid infrared light and deploying instruments on the surface of the moons. A suite of miniaturized instruments are investigated for deployment on the CubeSats. The CubeSats are designed to dock with the mothership to be refueled and they heavily leverage the design of the ARAPAIMA (www.eraucubesat.org) proximity operations 6U CubeSat currently in development at ERAU for the Air Force University Nanosatellite Program. The concept of operations envisions the launch of the mothership as a primary payload on a Mars transfer trajectory. After performing a Mars capture maneuver the mothership undertakes autonomous aerobraking to achieve a highly elliptic orbit with the apoapsis at Deimos altitude of 23,460km. Further maneuvering places the mothership in a relative orbit about Deimos from which the CubeSats are deployed. Once the investigation of Deimos is completed the mothership retrieves its CubeSats and maneuver to achieve a relative orbit about Phobos. An investigation similar to that of Deimos is performed. If the mass margins allow it then an extended mission will attempt to confirm the presence of a dust ring between Phobos and Deimos and conduct multi-point atmospheric investigations with supplemental 3U CubeSats.