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Moon Exploration – Part 1 (2A)

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COLMENA MISSION TO THE MOON

Abstract

Space exploration and economic exploitation of small bodies requires working in very low gravity and radiation exposed surfaces covered with regolith. This is extremely unsuitable for humans and represents a strong constraint on complex, and therefore massive, robots. With this perspective in focus, we are developing the lunar mission COLMENA, which will demonstrate the use of very small robots in such environments. COLMENA consist of nine $8x4$ cm rovers which will be carried to the Moon by the Peregrine lander from Astrobotic, and randomly deployed at the landing site at approximately 40 degrees north latitude. In the few hours following deployment, the units will autonomously evolve toward spatial clustering and mechanical and electrical interconnection. After attaining the latter two objectives, the units will keep measuring temperature and regolith deployment for the remaining lunar day. The definition of a small rover in this context is to have a height scale smaller than the Debye length, ensuring that the full unit is immersed in the electrostatically unbalanced dusty plasma of the limit layer on top of the celestial body, which is a very different and more challenging environment than that experienced by a larger system which can operate above this medium. We describe her the mission, its hardware and software, as well as current status, main technical challenges and adopted solutions. COLMENA will be the first Mexican lunar project with a strong pedagogic component, being a low-cost mission developed mainly by undergraduate students of engineering, physics and math.