Cover letter

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My research focuses on advancing miniature robotics and distributed wireless sensor networks to address challenges in planetary and deep space explorations faced by current platforms, such as single high-cost rovers and landers, for more efficient planetary and deep space exploration.

I developed low-cost, resource-efficient autonomous miniature robots for inspections and diagnostics on external surfaces of in-orbit spacecraft, as well as planetary rovers and landers. A notable project within this framework is the "AstroAnt": as the lead engineer, I designed a miniature robot slated for deployment to the Lunar South Pole in the IM-2 lunar mission in 2025. The AstroAnt is designed to be deployed on a Lunar Outpost MAPP-1 rover to the Lunar South Pole. The MAPP rover is carried by an Intuitive Machines Nova-C lander, which in turn rides aboard a SpaceX Falcon 9 rocket. The AstroAnt is designed to work on the top panel of the MAPP rover, collecting thermal data from various positions to monitor the rover's thermal system performance. The AstroAnt flight hardware has been delivered and sent to the Moon in February 2025. This is the smallest rover that has ever been sent to the Moon and part of the MIT “to the Moon to Stay” program.

Simultaneously, I have engineered miniature wireless sensor nodes designed to be ballistically deployed from rovers or landers to the Lunar surface. This platform allows for the simultaneous collection of data from different positions, extending exploration capabilities to hazardous or hard-to-reach areas where intriguing phenomena may be discovered. Three of my designed miniature wireless sensor nodes, named “HexSense” — a kind of self-oriented ballistic deployed wireless sensor nodes for future lunar exploration, have been successfully deployed and tested in Svalbard (Norway), the Canary Islands (Spain), and parabolic flights. They collected

local environmental data from the area of interest, such as lava tubes, and successfully performed self-orientation in a lunar gravity environment.

Looking ahead, my future work will be around how to use miniature, low-cost, distributed wireless sensor networks to facilitate future in-situ planetary exploration. Compared with the current traditional platforms, such as a single high-cost rover or lander, this platform can lower the total cost, guarantee robustness, increase scientific data value, and expand the exploration to hard-to-reach and dangerous areas.