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MARS HELICOPTER 2.0: SURVEYING THE RED PLANET FOR FUTURE HUMAN AND ROBOTIC  
EXPLORERS**Abstract**

The NASA Jet Propulsion Lab is currently designing and building a helicopter to accompany the Mars 2020 rover as a demonstration of an airborne vehicle operating on another planet. The current Mars Helicopter has limited capabilities and will only be able to perform technology demonstration with limited science return. The current helicopter is required to be within line of sight of the rover. Key benefits to a helicopter platform include the ability to navigate unsavory terrain that a rover would otherwise be unable to cross and to cover vast distances in short time. This technology demonstration helicopter does not capitalize on these advantages due to its line of sight and payload constraints.

A student team at the University of Michigan working under JPL mentorship has iterated on the current Mars Helicopter design to create a larger, more capable exploration system consisting of two helicopters, capable of larger science return. This system will utilize a bistatic radar to study the shallow Martian subsurface by varying the angle of incidence between the two helicopters. This allows the determination of the surface and subsurface composition and presence of liquid water or brine.

Our Mars Helicopter team leveraged a custom Matlab simulation to design a concept of operations that dictates the required transmission angles between two helicopters to navigate and answer critical questions that will inform future manned and sample return missions. Furthermore, the team verified the simulation results by testing a similar radar system in a simulated Mars environment with various soil compositions.

Our Mars Helicopter team went on to design the helicopter's power and thermal subsystem that will drive the remainder of the design. One of the goals of the study was to identify key technologies that need to be developed or matured for a helicopter to have sufficient power and payload capacity to perform worthwhile science.