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# TECHNOLOGIES FOR THE FIRST INTERSTELLAR EXPLORER: BEYOND PROPULSION

**Abstract**

A true interstellar robotic explorer would be able to reconfigure itself in both form and function to successfully achieve its mission [Freeman, Alkalai 2017]. Assuming advances in the development of propulsion systems - so our emissary can reach a significant fraction of light speed - when it arrives at its destination it will have to act autonomously to plan and execute mankind's first close encounter with another star system. This may include the ability to adapt itself to harnessing the energy of the host star to decelerate and collect enough energy to communicate with Earth, insert into orbit around the local planet and more. A significant challenge in defining such a mission is that our knowledge of the selected target star system, e.g. Proxima Centauri, is likely to evolve during the decades it takes our explorer to arrive at its destination. We may, for example, be able to assess the atmospheric composition of planetary bodies using spectroscopy, and discover the presence of a magnetosphere by detecting RF signatures of its interaction with the local stellar wind. From a unique vantage point 550 AU distant from our own Sun, we could use gravity lensing to image continent-scale features on the surface of such planets. The upshot may be that our robot explorer has to define its own science objectives and science value propositions, with limited input from mission control back on Earth, as it approaches its destination. Technologies that might be brought to bear in designing such a mission are 3-D printing to provide hardware upgrades en route, reconfigurable and self-repairing spacecraft subsystems, and genetic programming to provide software upgrades. Artificial intelligence promises to provide the level of decision-making needed for a robotic explorer at the other end of a 4-year-plus communication gap caused by the time taken for light (including RF signals) to travel such distances. A significant advantage of making our first interstellar explorer reconfigurable in both hardware and software is that its technology does not have to be frozen at around the time of launch. The latest developments back on Earth, within the constraints of the material solutions available on board the spacecraft, can be uploaded to keep the spacecraft near the leading edge of what is possible up to the time of encounter. The work described here was performed at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.