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AUTONOMOUS VEHICLE GUIDANCE NAVIGATION AND CONTROL FOR SPACE AND TERRESTRIAL APPLICATIONS

Abstract

Mobile robotics has enabled scientific breakthroughs in planetary exploration, but due to long communication delays and narrow windows of opportunity for communication, these returns have been limited. To increase the benefit of the next planetary exploration missions, next generation rovers (e.g., Mars 2020 from NASA and ExoMars from ESA NASA) will have to traverse long distances (on the order of hundreds of metres to a kilometre) per sol autonomously, or at least with minimum interaction with Earth-based operators. In this context, planetary rovers will require the ability to sense, model and assess the 3D environment, plan obstacle-free paths toward a destination, and autonomously navigate along those paths.

For the last decade, MDA has been developing Guidance, Navigation and Control (GNC) capabilities to enable long-range, fully autonomous navigation in space-analogue environments. These technologies extend MDA's heritage in providing robust control systems for flight programs. MDA's vision is to provide the best performance given realistic flight-representative computational platforms; this contrasts the current trend in academic research which is narrowing the performance (for example, the often-quoted 1 % relative localization accuracy goal) by using increasingly computationally intense algorithms with diminishing returns. This poster will present MDA GNC technology and illustrate the field trials conducted in planetary-analogue environments using different classes of rovers, ranging from off-the-shelf laboratory rovers to underground mining laud-haul-dump vehicles, to prototype planetary exploration rovers for the Canadian Space Agency.

The field trial results from various terrains and divers rovers have shown that MDA's GNC has a high level of maturity, robustness, and accuracy. Future work will continue to validate algorithms through field trials in representative environments, as well as porting GNC algorithms to lower-power computing hardware (e.g., FPGAs). These activities will ensure that the capabilities are ready for flight, and will be spun off to terrestrial applications (e.g., mining, security, and military robotics).