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REINFORCED DEEP LEARNING FOR ENHANCED MARS ROVER AUTONOMY

Abstract

Mars rovers will require considerably higher levels of autonomy than previous models to navigate challenging terrain and the long periods of communication latency. In this work, we offer reinforced deep learning as a potential way to redesign the fundamental approach to the Mars rover autonomy. The goal, however, is to enable a rover to learn and adapt in real time, to make decisions in high-dimensional path planning that current traditional decision-making models cannot, thus enhancing the effectiveness of a rover on the Martian surface. We employ state-of-the-art deep reinforced algorithms to design a AI rover control system based on data gained through model trainings. The rover agent learns by trial-and-error to reach goals, avoid threats and manage its resources in highly detailed, realistically simulated virtual Martian environments. A safe and efficient strategy such as the route to take around obstacles or how to conserve energy, is rewarded and a neural network policy is refined progressively based on this feedback. The rover is not controlled by pre-programmed instructions that it follows blindly but learns from experience and does not face unexpected events such as changes in the terrain or equipment faults. Theinitial computational models are showing large improvements compared to standard methods. Therefore, the path planning of this deep learning trained rover is more efficient and finds shorter paths to its destinations. It shows much better adaptability. Our work presents a concrete way to achieve AI implemented autonomy for planetary exploration. By enabling rovers to make their own decisions, it provides solutions to critical challenges during Mars missions such as limited communication periods, dynamic environments and may also decrease the workload on operators. These techniques are directly applicable to future rover projects and can be implemented by aerospace organizations to enhance their mission capabilities. This deep learning framework is also scalable and opens the door for future autonomous robots on Mars, on the Moon, and beyond. In the days of rapid aerospace technology evolution, reinforced deep learning can significantly enhance the long term sustained performance and upgradability of planetary rovers