Evaluating Potential Trajectories For a Return Trip From Mars

Aidan Gallagher

Math Evolutions

Kristen Fye & Allison Hahn Elowsen

Summer Ventures in Science and Mathematics

The University of North Carolina at Charlotte

Abstract

Humans have been enamored by the possibility of interplanetary travel for hundreds of years. Unfortunately, optimal interplanetary trajectories for rockets have small windows of time for launch and relatively large time gaps in between those windows. This paper seeks to explore alternative trajectories for a manned spacecraft to return to Earth from Mars that do not occur within a launch window and enable a shorter stay on Mars. Using the spaceflight simulator Kerbal Space Program, several simulations were conducted that had different stay-times on Mars and different return trajectories. The fuel required and time spent in transfer for these trajectories were recorded and compared to a control simulation that flew back to Earth during the launch window. The simulation that utilized a gravity assist trajectory was not more fuel efficient nor shorter in total mission duration compared to the control simulation. However, the shorter surface stay compared to the control simulation may have positive implications for reducing astronaut's exposure to health risks associated with longer stay times.