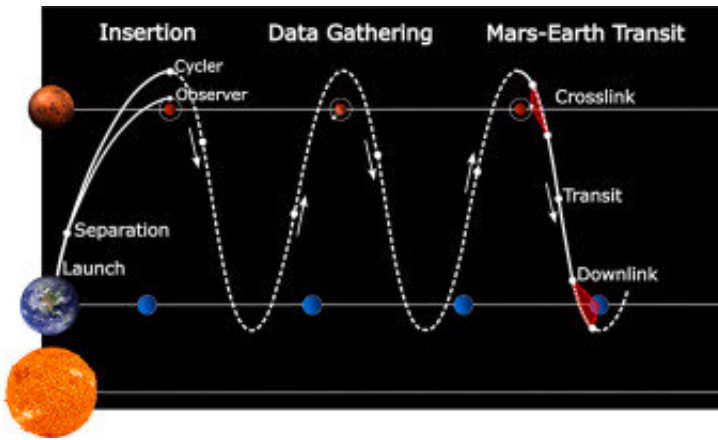


New research models concept for data transport using train of satellites

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Concept of operations for one cycloidal spacecraft. Credit: The Grainger College of Engineering at University of Illinois Urbana-Champaign

Although the Pony Express lasted only a short time in the mid-1800s before being outperformed by the transcontinental telegraph, it inspired a concept for a string of small satellites to transport data from Mars to Earth and help alleviate the data logjam currently occurring in the Deep Space Network.

"The Solar System Pony Express is a mission concept that aims to augment the data transmission capabilities of the Deep Space Network using the idea of data mules," said Robyn Woollands, assistant professor in the Department of Aerospace Engineering at the University of Illinois Urbana-Champaign.

Woollands described the data mules as [small spacecraft](#) that can travel to a [remote location](#), such as Mars, where they acquire data in close range to the probe's transmitter, then carry the data back to Earth where it is downlinked in close range to the receiver. This enables high latency and high bandwidth communication.

"A network of interplanetary data mules could be established using cycler orbits," Woollands said. "After launch, the data mules use their own low-thrust propulsion system to inject into a cycler orbit and target subsequent flybys of Earth and Mars."

Woollands explained that the trajectories encounter two or more [celestial bodies](#) along their path and require a modest amount of propellant for correction maneuvers. After launch, the data mules use their own low-thrust propulsion system to inject into a cycler orbit and target subsequent flybys of Earth and Mars.

"During the Mars flybys, data is uplinked from spacecraft already operating at Mars—on [orbit](#) or on the surface—and during Earth flybys data is downlinked back to Earth," said Woollands.

She said her Ph.D. student Alex Pascarella developed the tools to enable the trajectory design and optimization of Earth/Mars cycler orbits for the Solar System Pony Express mission.

"We simulate trajectories that make use of low-thrust propulsion and include a high-fidelity model that incorporates the gravity of the Sun, Earth and Mars", said Pascarella.

Low-thrust space missions are becoming more common due to the benefits afforded by ion engines, which are more efficient than chemical engines. They are also smaller/lighter which allows for the design of smaller spacecraft that can be launched economically as a secondary

payload.

"Our study revealed that the total [data](#) volume returned during the simulated mission exceeded our goal of 1 Petabit per year," said Alex Pascarella, Robyn Woollands' Ph.D. student.

The study is published in the journal *Acta Astronautica*.

Solar System Pony Express is a NASA Innovative Advanced Concept project led by Joshua Vander Hook at NASA's Jet Propulsion Laboratory.

More information: Alex Pascarella et al, Low-thrust trajectory optimization for the solar system pony express, *Acta Astronautica* (2022). [DOI: 10.1016/j.actaastro.2022.11.046](https://doi.org/10.1016/j.actaastro.2022.11.046)

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