

# Solar Sail Trajectories to the Planets

John Clouse

Most interplanetary spacecraft have used finite burns to escape Earth orbit and be captured by their destination's gravity. The propellant expended for these maneuvers is a large part of the mass and cost for these missions. If the hyperbolic excess velocity at departure and/or arrival could be reduced, propellant mass could be saved. Solar sails are an attractive technology to potentially lessen propellant expenditure. Solar sails convert solar photon momentum to spacecraft acceleration, providing a free – and potentially continuous – propulsion source. This propulsion system is only limited by sail size, reflective parameters, and orientation to the sun. This project will seek to determine the savings in hyperbolic excess velocity at departure and arrival for a baseline spacecraft and steering angle.

## Bibliography

1. Stevens, R., Ross, I.M., and Matousek, S, "Earth-Mars Return Trajectories Using Solar Sails," 55<sup>th</sup> *International Astronautical Congress 2004*, IAC-04-A.2.08, Vancouver, Canada, 2004.
2. Vallado, D, "Continuous-Thrust Transfers," *Fundamentals of Astrodynamics and Applications*, 4<sup>th</sup> ed., The Space Technology Library, Hawthorne, CA, 2013, pp. 371-388.
3. McInnes, C., *Solar Sailing: Technology, Dynamics, and Mission Applications*, Springer, 2004.