

Robust Multi-objective Trajectory Optimization in the CR3BP

Tatay-Sanguesa, Jose; Wiegand, Andreas; Noomen, Ron

Publication date

2021

Document Version

Final published version

Citation (APA)

Tatay-Sanguesa, J., Wiegand, A., & Noomen, R. (2021). *Robust Multi-objective Trajectory Optimization in the CR3BP*. Abstract from IAF Astrodynamics Symposium 2021 at the 72nd International Astronautical Congress, IAC 2021, Dubai, United Arab Emirates.

Important note

To cite this publication, please use the final published version (if applicable). Please check the document version above.

Copyright

Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy

Please contact us and provide details if you believe this document breaches copyrights. We will remove access to the work immediately and investigate your claim.

IAF ASTRODYNAMICS SYMPOSIUM (C1)
Mission Design, Operations & Optimization (2) (5)

Author: Mr. Jose Tatay-Sanguesa
Astos Solutions GmbH, Germany

Mr. Andreas Wiegand
Astos Solutions GmbH, Germany
Ir Ron Noomen
Delft University of Technology (TU Delft), The Netherlands

ROBUST MULTI-OBJECTIVE TRAJECTORY OPTIMIZATION IN THE CR3BP

Abstract

Orbital mission analysis is an iterative procedure in which in principle an infinite number of solutions is tested until the one that best fulfils mission objectives is selected. With new missions defined in the Circular Restricted Three-Body Problem becoming more frequent, the mission analysis process for trajectories within this model must be improved. So far, most of the research efforts have been devoted to finding an algorithm that provides the minimum ΔV solution for a particular problem. This study presents a novel approach whose aim is to improve the initial phase of mission design by providing a multitude of optimal solutions that cover the majority of the trajectory possibilities. This should be performed without an initial guess input from the user, nor any kind of previously known solution, so that it can be applied to a wide variety of transfer problems.

In order to do so, the proposed research performs a multi-objective optimization on direct and manifold transfers simultaneously, and places the non-dominated solutions in a Pareto front. In this way, the user is able to easily choose which solution better meets the requirements in terms of ΔV and time of flight. Once the solution is chosen, it can be used as a first guess for a further optimization with the ASTOS software, which increases the accuracy and reliability of the results, by being verified in a higher-fidelity model using a n-body problem and continuous thrust arcs.

To achieve this purpose, the tool has been designed in collaboration with Astos Solutions GmbH and TU Delft, carefully selecting the design variables that completely define direct and manifold trajectories with the least amount of a priori information. Then MIDACO, a global search ant colony optimizer, is used to find the best solutions.

The results obtained include, for a sample case of a LEO to 9:2 resonance Earth-Moon L_2 NRHO, a Pareto front populated with optimal solutions, with a time of flight ranging between two and sixty days. Moreover, the overall process is fast, averaging a computational time in the order of a few hours for the cases analysed.