

Review of Lambert's problem

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Lambert's problem is the orbital boundary-value problem constrained by two points and elapsed time. It is one of the most extensively studied problems in celestial mechanics and astrodynamics, and, as such, it has always attracted the interest of mathematicians and engineers. Its solution lies at the base of algorithms for, e.g., orbit determination, orbit design (mission planning), space rendezvous and interception, space debris correlation, missile and spacecraft targeting.

There is abundance of literature discussing various approaches developed over the years to solve Lambert's problem. We have collected more than 70 papers and, of course, the issue is treated in most astrodynamics and celestial mechanics textbooks. From our analysis of the documents, we have been able to identify six or seven main solution methods, each associated to a number of revisions and variations, and many, so to say, secondary research lines with little or no posterior development. We have ascertained plenty of literature with proposed solutions, in many cases supplemented by performance comparisons with other methods, but we have detected a surprising scarcity of reviews on the subject.

We believe that a review concerning Lambert solvers is needed, also to adapt their discussion to the rapid changes and evolution in computation and storage capabilities that characterize our times, on the one hand, and to the performance requirements imposed by current applications, on the other. Our study consists in a quantitative, exhaustive and transversal comparison among the existing methods for the solution of Lambert's problem. The analysis is based on the following issues:

- choice of the free parameter
- number of iterations
- computing cost
- generality of the mathematical formulation
- limits of applicability (degeneracies, domain of the parameter, special cases and peculiarities)
- accuracy
- suitability to automatic execution

The final objective of the study is to offer a clear and organized insight into the literature and to indicate the solvers with the best qualities.