# NONLINEAR OPTIMISATION AND THE ASTEROID IDENTIFICATION PROBLEM

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The classical procedure of differential correction allows to improve orbits for which new observations are available; however, it works only provided the original orbit is within the convergence domain of the pseudo–Newton method. Given the strong nonlinearity of the problem, this occurs only when the residuals of the new observations with respect to the old orbit are quite small. On the contrary, if a single opposition asteroid, observed only on a short arc, is not recovered for several years, then the position uncertainty of the asteroid grows to a very large size, until the asteroid is "lost", that is it can be in widely separated regions of the sky. In this case, if the same asteroid is observed again, the identification with the already known one can be very difficult, and even when the identification is performed correctly the differential correction algorithm can fail. The only lost asteroid in the numbered asteroid list is now *719 Albert*, lost since 1911. If the proposed *Spaceguard survey* will be realized, the problem of identifying millions of new discoveries within catalogues of comparable size will be one of the main challenges.

We have begun experimenting with a new algorithm of orbit determination, which is capable of performing both positive and negative identification of asteroids lost since many years. We are using *LANCELOT*, a software system developed by Conn, Gould and Toint to handle large and constrained nonlinear optimisation problems. We have implemented the asteroid orbit determination, in the case of two widely separated observed arcs, as a nonlinear least squares problem; so far we are experimenting with a model problem (i.e. 2–body orbits). The nonlinearity of the problem is mitigated by cutting the orbit between the two observed arcs into a large number (e.g. 50) of small arcs; the joining of each small arc with the next one is given as a nonlinear constraint. We report on the performance and applicability of this method to obtain both positive identification (hence orbit improvement) and negative identification (when the obtained minimum is too high, proving that the two observed arcs are incompatible).