Geophysical Research Abstracts
Vol. 15, EGU2013-3733, 2013
EGU General Assembly 2013

Fast integer least squares estimation methods: applications-oriented review and improvement

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The integer least squares (ILS) problem, also known as the weighted closest point problem, is highly interdisciplinary, but no algorithms can find its global optimal integer solution in polynomial time. In this talk, we will review fast algorithms for estimation of integer parameters. First, we will outline two suboptimal integer solutions, which can be important either in real time communication systems or to solve high dimensional GPS integer ambiguity unknowns. We then focus on the most efficient algorithms to search for the exact integer solution, which is shown to be much faster than LAMBDA in the sense that the ratio of integer candidates to be checked by efficient algorithms to those by LAMBDA can be theoretically expressed by r^m, where $r < 1$ and m is the number of integer unknowns. Finally, we further improve the searching efficiency of the most powerful combined algorithms by implementing two sorting strategies, which can either be used for finding the exact integer solution or for constructing a suboptimal integer solution. A test example clearly demonstrates that the improved methods can perform significantly better than the most powerful combined algorithm to simultaneously find the optimal and second optimal integer solutions.
More mathematical and algorithmic details of this talk can be found in Xu (2001, J Geod, 75, 408-423); Xu (2006, IEEE Trans Information Theory, 52, 3122-3138); Xu (2012, J Geod, 86, 35-52) and Xu et al. (2012, Survey Review, 44, 59-71).