Subsquares Approach – Simple but Efficient Scheme for Solving OILS

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Abstract

In our talk we will consider the problem of computing enclosures of solution sets of overdetermined interval linear systems (OILS). By a solution set of an interval linear system $\boldsymbol{A}x = \boldsymbol{b}$ we mean

$$\Sigma = \{x \mid Ax = b \text{ for some } A \in \boldsymbol{A}, b \in \boldsymbol{b}\}.$$

It is appropriate to point out, that this approach is different from the least squares method.

We would like to talk about a general scheme – Subsquares Approach – for design of algorithms for solving OILS. The key idea is simple but it turned out to be efficient for some classes of problems – systems with relatively wide intervals. We use equations of original overdetermined system to form new square systems and then we provide some further work to gain a sharp interval enclosure of the solution set.

We would like to show, how this scheme could be applied in development of new algorithms. First we derive a naive algorithm. It can be very time consuming, but for noodle-like or near-square systems it can return an enclosure really close to the interval hull. The following sequential algorithm will be more sophisticated and less memory and time consuming. The advantage of both methods is that they can reveal an empty solution set of OILS very quickly (unlike e.g. least squares approach that returns solution in every case). Moreover, both methods can be easily parallelized. Numerical comparison will be showed and further research and open problems will be stated.

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