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Conjectures in Real Algebra and Polynomial Optimization through High Precision Semidefinite Programming

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We study degree bounds for the denominator-free Positivstellens »atze in real algebra, based on sums of squares (SOS), or equivalently the convergence rate for the moment-sums of squares hierarchy in polynomial optimization, from a numerical point of view. As standard semidefinite programming (SDP) solvers do not provide reliable answers in many important instances, we use a new high-precision SDP solver, Loraine.jl, to support our investigation. We study small instances (low-degree, small number of variables) of one-parameter families of examples, and propose several conjectures for the asymptotic behavior of the degree bounds. Our objective is twofold: first, to raise awareness on the bad performance of standard SDP solvers in such examples, and then to guide future research on the Effective Positivstellensätze. Joint work with Lorenzo Baldi.

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