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Gabor Pataki* (gabor@unc.edu), Department of Statistics, and Operations Research, UNC Chapel Hill, Chapel Hill, NC 27599, and **Aleksandr Touzov** (touzov@live.unc.edu), Department of Statistics, and Operations Research, UNC Chapel Hill, Chapel Hill, NC 27599.
How do exponential size solutions arise in semidefinite programming?

As a classic example of Khachiyan shows, some semidefinite programs (SDPs) have solutions whose size – the number of bits needed to describe them – is exponential in the size of the input. Such large solutions are the main obstacle to solving a long standing open problem: can we decide feasibility of SDPs in polynomial time?

The apparent consensus is that SDPs with large solutions are pathological and rare. On the contrary, we show that a linear change of variables transforms every strictly feasible SDP into a Khachiyan type SDP, in which the leading variables have large size. As to “how large,” it depends on the geometry of the SDP instance and the singularity degree of a dual problem. We further show that in some SDPs large variables appear naturally, without any change of variables. (Received January 19, 2021)