Numerically Computing Low-Rank Decompositions of Sums of Squares of Rational Functions via a Matrix Rank Minimization Problem

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Abstract: Recently several problems in some areas, such as in engineering, can be reformulated as optimization problems over either positive (semi)definite matrices or non-negative, sum-of-squares polynomials. Artin proved the 17th problem of Hilbert saying that any non-negative real polynomial can be expressed as a sum of squares of rational functions. But the form of the common denominator of rational functions have not been justified.

This study proposes a method of finding low-rank decompositions of non-negative real polynomials as sums of squares of rational functions (*sosrf-decompositions*). This method is based on numerically solving the problem of finding a matrix of minimal rank that satisfies a given system of quadratic equations. The performance is implemented in MATLAB. The numerical result leads us to a conjecture on the form of the common denominator of rational functions in sosrf-decompositions.

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