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Expressing a Fraction of Two Determinants as a Determinant

Suppose the polynomials f and g in $\mathsf{K}[x_1, \ldots, x_r]$ over the field K are determinants of $m \times m$ and $n \times n$ matrices, respectively, whose entries are in $\mathsf{K} \cup \{x_1, \ldots, x_r\}$. Furthermore, suppose $h = f/g$ is a polynomial in $\mathsf{K}[x_1, \ldots, x_r]$ and suppose that K has at least $m + 1$ elements. We construct an $s \times s$ matrix C whose entries are in $\mathsf{K} \cup \{x_1, \ldots, x_r\}$, such that $h = \det(C)$ and $s = O\big((m+n)^6\big)$. Our problem was motivated by resulant formulas derived from Chow forms.

Additionally, we show that divisions can be removed from formulas that compute polynomials in the input variables over a sufficiently large field within polynomial formula size growth.

This is joint work with Pascal Koiran at the ENS Lyon, France.