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On Hilbert Covariants

Let

$$F(x_1, x_2) = a_0\, x_1^d + a_1\, x_1^{d-1}\, x_2 + \cdots + a_d\, x_2^d, \qquad (a_i \in \mathbf{C})$$

denote a homogeneous binary form of order d. Assume that d factors as $d = r\, m$. The Hilbert covariant $\mathcal{H}_{r,d}(F)$ is a binary form (whose coefficients are polynomials in the $\{a_i\}$) with the following property: $\mathcal{H}_{r,d}(F)$ vanishes identically, exactly when F is a perfect m-th power of an order r form. It was constructed by Hilbert in 1885; and in particular, $\mathcal{H}_{1,d}(F)$ is the Hessian of F.

I will exhibit two entirely different approaches to the construction of $\mathcal{H}$, and outline a proof of the fact that they lead to the same object. I will also mention some results and problems about the ideal generated by the coefficients of $\mathcal{H}$. All of this is joint work with A. Abdesselam from the University of Virginia.