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*Hypoellipticity via sums of squares*

Many results on hypoellipticity of second order operators rely on the assumption that the operator can be written as a sum of squares of vector fields (e.g. Hormander's bracket condition, and Christ's hypoellipticity theorem for infinitely degenerate operators). For operators that are not subelliptic and not sums of squares, hypoellipticity have been only proved in some very special cases, for example, when  $L = L_1 + g(x)L_2$  and  $L_1$  and  $L_2$  are subelliptic. In this talk I will address the question of hypoellipticity for a general divergence form operator, whose matrix is comparable, but not necessarily equal, to a diagonal matrix of a special form. The idea is to find sharp sufficient conditions which guarantee that a smooth positive matrix can be written as a sum of squares of positive dyads with sufficient degree of smoothness. Interestingly, this question have not been completely resolved even for scalar positive functions.