COLLOQUIUM

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Blowup-polynomials of graphs

Mathematics and Statistics

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Abstract: Given a finite simple connected graph $G = (V, E)$, we introduce a novel invariant which we call its blowup-polynomial $p_G(n_v : v \in V)$. To do so, we compute the determinant of the distance matrix of the graph blowup, obtained by taking n_v copies of the vertex v, and remove an exponential factor.

- First: we show that as a function of the sizes n_v, p_G is a polynomial, is multi-affine, and is real-stable.
- Second: we show that the multivariate polynomial p_G is intimately related to the characteristic polynomial q_G of the distance matrix D_G, and that it fully recovers G whereas q_G does not.
- Third: we obtain a novel characterization of the complete multi-partite graphs, as precisely those whose "homogenized" blowup-polynomials are Lorentzian/strongly Rayleigh.
- Finally: we show how to obtain from p_G a novel delta-matroid for every graph. We also provide a second delta-matroid for every tree, which too is hitherto unexplored, but whose construction does not extend to all graphs.

(Joint with Apoorva Khare.)

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