Detecting outliers with Christoffel-Darboux kernels

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Time: Thursday 25.07., 12:00 - 12:30, Room HS 3

Abstract: Two central objects in constructive approximation, the Christoffel-Darboux kernel and the Christoffel function, are encoding ample information about the associated moment data and ultimately about the possible generating measures. We develop a multivariate theory of the Christoffel-Darboux kernel in $\mathbb{C}^d$, with emphasis on the perturbation of Christoffel functions and their level sets with respect to perturbations of small norm or low rank. The statistical notion of leverage score provides a quantitative criterion for the detection of outliers in large data. Using the refined theory of Bergman orthogonal polynomials, we illustrate the main results, including some numerical simulations, in the case of finite atomic perturbations of area measure of a 2D region. Methods of function theory of a complex variable and (pluri)potential theory are widely used in the derivation of our perturbation formulas. *Joint work with Mihai Putinar (University of California at Santa Barbara), Edward B. Saff (Vanderbilt University) and Nikos Stylianopoulos (University of Cyprus).*