Asymptotic Spectral Distributions for Strongly Regular Graphs and Bivariate Orthogonal Polynomials

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Abstract

Let G be a strongly regular graph with eigenvalues $s(G) < r(G) \leq k(G)$, and $\bar{G}$ the complement which is known to be strongly regular. We consider the Cartesian powers G^n and $\bar{G}^n$, and their adjacency matrices A_n and $\bar{A}_n$, respectively. We are interested in the joint spectral distribution of $(A_n, \bar{A}_n)$ in the canonical tracial state. Following Hora [1], where the asymptotic spectral distributions of Hamming graphs $H(n, v) = K_v^n$ was first investigated, we obtain the asymptotic spectral distributions of $(A_n, \bar{A}_n)$ as $n \to \infty$ with proper scaling balance with $s(G), r(G), k(G)$. The limit distribution is described in terms of Gaussian and Poisson distributions, and the corresponding orthogonal polynomials are the limit of bivariate Krawtchouk polynomials, a particular class of Aomoto–Gelfand hypergeometric functions.

It is our hope to establish along the above line a bivariate extension of the method of quantum decomposition [2, 4]. This talk is based on the recent joint work with J. Morales and H. Tanaka [3].

[1] A. Hora: *Central limit theorems and asymptotic spectral analysis on large graphs*, Infin. Dimen. Anal. Quantum Probab. Relat. Top. **1** (1998), 221–246.

[2] A. Hora and N. Obata: "Quantum Probability and Spectral Analysis of Graphs," Springer, 2007.

[3] J. V. S. Morales, N. Obata and H. Tanaka: preprint, 2018.

[4] N. Obata: "Spectral Analysis of Growing Graphs," Springer, 2017.