Pseudo-Hermitian ensemble of random Gaussian matrices

G. Marinello[1], M. P. Pato[2]
Instituto de Física, Rua do Matão 1371, Universidade de São Paulo, 05508-090, São Paulo, S.P., Brazil
gamasosa@gmail.com[1], mpato@if.usp.br[2]

It is shown how pseudo-Hermiticity, a necessary condition satisfied by operators of PT symmetric systems can be introduced in the orthogonal, unitary and sympletic Gaussian classes of random matrix theory[1]. The method consists in the introduction of projection operators to perform a decomposition of the matrices into diagonal and off-diagonal blocks. It is shown that the form of the off-diagonal blocks that couple the diagonal ones is determined by imposing the pseudo-Hermiticity condition. The joint density distribution of matrix elements is analitically derived and, from it, an ansatz is proposed that describes the localization of the complex eigenvalues inside an ellipse determined by the strength of the coupling. The ansatz is confirmed by numerical simulations. In the model, the pseudo-Hermitian nature of each of the matrices' blocks may vary, and the connection between them is controlled by coupling parameters in the off-diagonal blocks as well as the size of the blocks. This leads to a model that describes transitions from real eigenvalues to a situation in which, apart from a residual number, the eigenvalues are complex conjugate. It is also shown how the block decomposition relates to the basic PT symmetric complex Hamiltonians[2]. The present results extend previous recent ones obtained with ensemble of tridiagonal matrices[3, 4, 5].

References

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