Scattering in quantum graphs

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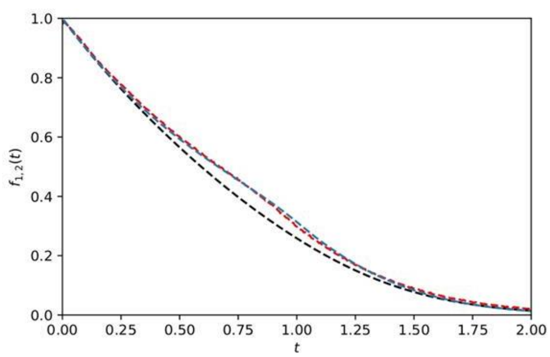
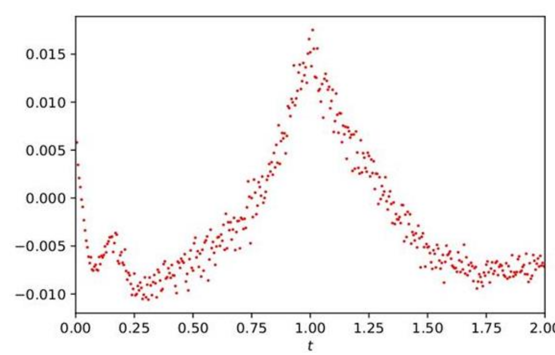
Quantum chaos is the study of quantum systems whose classical counterpart is chaotic. The conjecture of quantum chaos states that the same universal properties characterize those systems as the Gaussian random matrices [1]. Many experimental works give validity to this conjecture [2-3]. Quantum graphs turn out to be systems that due to their simplicity are useful to study quantum chaos [4-6]. Their use dates back to Linus Pauling in 1930, but they became relevant when Kottos and Smilansky introduced quantum graphs as a powerful tool to study quantum chaos, they also showed that connecting semi-infinite wires to their vertices becomes a system with dispersion. The scattering fidelity "SF" measures the sensitivity of the scattering matrix under a perturbation [7]. The SF provides a useful tool since SF can be measured experimentally (unlike fidelity). In addition, when the coupling is weak, the SF coincides with the fidelity. It is worth mentioning that SF is a powerful tool to study the nature and strength of a perturbation [9]. For quantum graphs, it is unknown what type of perturbation is introduced to the system when the length of some (or all) bounds are changed. This work presents numerical studies of the level statistics for closed graphs with the 3 types of symmetries (GOE, GUE, and GSE). In addition, we also present studies of the scattering fidelity. Furthermore, studies of autocorrelation and cross-correlation (like [9]) of elements of the scattering matrix where we found deviations concerning the predictions made for the random matrix theory. We believe that these deviations could be due to the existence of correlations between the eigenvalues and the components of the eigenvectors of the secular matrix h.





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