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Exceptional Point and Diaboloic Point Sensors

Abstract: Exceptional point (EP) and diaboloic point (DP) sensors represent cutting-edge technologies in the field of optical sensing, offering significantly enhanced sensitivity for detecting minute perturbations. This work investigates the fundamental differences between Hermitian and non-Hermitian systems, with a particular focus on the role of EPs and DPs in sensing applications. Non-Hermitian systems, unlike their Hermitian counterparts, exhibit complex eigenvalues and non-unitary evolution due to inherent gain and loss, which enables phenomena like PT-symmetry and exceptional points. This presentation covers the historical background, starting from theoretical advancements in PT-symmetry and its experimental verification in optics, leading to the development of EP-based sensors. The primary objective is to explore how EP-based sensors, through increased eigenvalue splitting, offer superior sensitivity over DP-based sensors, despite their higher sensitivity to perturbations, which complicates their operational stability. The methodology involves studying EP and DP behaviors in whispering-gallery mode (WGM) resonators, highlighting their applications in single nanoparticle detection and real-time analysis. Results demonstrate that EP sensors exhibit enhanced performance in terms of sensitivity and precision compared to DP sensors, but maintaining stable operation at an EP remains challenging due to susceptibility to external perturbations. The presentation concludes by discussing the potential applications of EP and DP sensors in bioelectronics, healthcare, and environmental monitoring, emphasizing their potential for high selectivity, stability, and improved sensor performance in complex environments.

Keywords: Exceptional points, Diaboloic points, Optical sensing, PT-symmetry, Nanoparticle detection, Whispering-gallery mode

Biography: I am Jyoti Sheoran, a Third-year Ph.D. student at the Engineering Science and Mechanics Department at Pennsylvania State University. I have completed my master's from the Indian Institute Of Technology (Indian School Of Mines), Dhanbad. I have experience in Fiber optics, Optical resonators, and Optical sensing on exceptional surfaces to increase the sensing. I have experience in non-linear optics and created optical sensors. I also have a patent titled “**Fiber Optic Intrusion Detection Device**”.