Contribution ID: **44** Type: **Poster + Flashtalk**

EagleEye: A general-purpose density anomaly detection method

Modern high-energy physics experiments generate massive, high-dimensional datasets that demand advanced strategies for anomaly detection. This talk presents *EagleEye*, a novel density-based method designed to compare two multivariate distributions on a point-by-point basis using a distribution-free approach rooted in Bernoulli and binomial statistics. *EagleEye's* deterministic framework, which analyzes local neighborhoods to pinpoint deviations, can be shown to outperform established techniques on challenging domain searches such as the LHC Olympics R&D dataset in a completely unsupervised manner, without the need to specify signal regions and/or control regions, or any other weakly-supervised prescription. In this talk I will discuss the statistical properties of *EagleEye*, detailing how the algorithm remains computationally efficient and parallelizable, whilst explaining how the method can locate anomolous regions of over/underdensity in feature space, and even estimate the total and local signal-to-background ratio. I will also show how *EagleEye* can be readily adapted to a diverse range of science tasks—from new particle searches to climate data.

AI keywords

Anomaly detection; unsupervised learning; theory

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Track Classification: Patterns & Anomalies