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Approximating the COSI Telescope Response with Neural Networks

The Compton Spectrometer and Imager (COSI), a gamma-ray telescope set to launch in 2027 as a NASA Small Explorer satellite mission, is a compact Compton telescope consisting of a cross-strip germanium detector array. Owing to its wide field-of-view and excellent energy resolution, COSI is set to achieve an unprecedented angular resolution and line sensitivity among Compton telescopes in the 0.2-5 MeV energy band.
This requires a precise characterization of the instrument response, which is challenging to achieve with a traditional multi-dimensional binned response.
We therefore pursue a novel approximation scheme, consisting of a conditional autoregressive spline flow neural network and a spherical harmonics expansion, working in a dedicated relative coordinate space, to obtain a detailed model of the response function.
Early applications in unbinned maximum likelihood analysis, including RL-deconvolution and spectral fitting, underscore the broad utility of our method. This continuous approach has the potential to overcome the inherent limitations of conventional discretized models, effectively bridging the gap between COSI's innovative design and the practical challenges of gamma-ray data analysis.

Collaboration(s)

COSI

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