







taurex-emcee: a TauREx 3.1 plugin for the emcee sampler

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Summary

taurex-emcee is a plugin for the TauREx 3.1 atmospheric retrieval framework ([A. F. Al-Refaie et al., 2021](#)) that extends the choice of sampling methods available to the user. The plugin implements an interface to the [emcee](#) sampler ([Foreman-Mackey et al., 2013](#)), which is a popular affine-invariant ensemble sampler widely used in the astronomy community. The interface is automated by adopting the [autoemcee](#) package by Johannes Buchner, which also handles parallelization. Thus, the taurex-emcee plugin enables users to launch parallelized retrievals using the emcee sampler in a straightforward manner. This allows fast retrievals of exoplanet atmospheric spectra, especially when coupled with the GPU-accelerated forward models of the TauREx 3.1 framework ([A. Al-Refaie et al., 2020](#)).

Benchmark

Emcee vs MultiNest

Statement of need

Optimized sampling methods are a key component of any retrieval code. Nested samplers ([F. Feroz et al., 2009](#); [Farhan Feroz et al., 2019](#)) are a powerful and robust sampling method, successfully applied to the retrieval of exoplanet atmospheric spectra ([Barstow et al., 2020](#); [Bocchieri et al., 2023](#); [Changeat et al., 2020](#)). TauREx 3.1 natively implements a suite of nested samplers, including the [MultiNest](#) sampler, or makes them available as plugins, such as the [UltraNest](#) sampler. The primary target of nested samplers is the efficient calculation of the Bayesian evidence, whilst the inference of the posterior is a by-product. This is regarded as a key advantage of nested samplers, as the evidence can be readily used for model selection. However, the evidence is not always required, and the interpretation of the posterior from nested samplers necessitates some care. Additionally, algorithmic assumptions of nested samplers may require to tailor the priors to explore the parameter space thoroughly.

Where the inference of the Bayesian posterior is the primary target, a well-established alternative to nested samplers are a family of Markov chain Monte Carlo methods known as affine-invariant ensemble samplers ([Goodman & Weare, 2010](#)). The implementation in [emcee](#) ([Foreman-Mackey et al., 2013](#)) is a popular choice in the astronomy community, as it takes care of the heavy lifting of the sampling process, is well documented, and is straightforward to

utilize. To date, the emcee sampler is not natively implemented in the TauREx 3.1 retrieval framework. To fill this gap, we developed the taurex-emcee plugin, which interfaces the emcee sampler to TauREx 3.1, expanding the choice of sampling methods available to the user.

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