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Surrogate modelling of kilonova spectra using conditional variational autoencoders

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In this work, we use variational autoencoders to build a surrogate for the model spectra of optical counterparts to neutron star containing gravitational wave events. Optical counterparts to gravitational wave events reveal information that is not necessarily included in the gravitational wave signal. Modeling of these radioactively-powered time-domain transients, kilonovae, is computationally intensive and yields spectra at discrete times. To use such models within analysis frameworks where a continuous model is required, surrogate models are built, often with further simplifications to reduce data dimensions and thus computation time. Machine learning techniques offer an alternative approach to common surrogate model building methods. We explore using conditional variational autoencoders to build a neural network based surrogate model for kilonova spectra models. We find that, while the surrogate model struggles to reconstruct the spectra exactly, the agreement in bolometric luminosities is within 3%, signaling that the model is learning the general structure of the data. Further, we provide a detailed error verification study on the models. Our model seems to work well enough to be appropriate for use within current kilonova analysis studies.

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