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Reconstructing neutron star equation of state from observational data via automatic differentiation

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Neutron stars harbor extreme conditions unattainable in terrestrial laboratories,
making them ideal candidates to study the equation of state (EoS) of strongly interacting matter. Advancements in the measurements of neutron star masses, radii
and tidal deformabilities through electromagnetic and gravitational wave observations have made it feasible to add further constraints on the EoS. In this work, we present a novel method that exploits deep learning techniques to reconstruct the neu-tron star EoS from mass-radius (MR) observations. Our approach makes use of an unsupervised learning procedure in the Automatic Differentiation framework to optimize the EoS. We demonstrate that our proposed method successfully reconstructs the EoS using merely 12 mock MR data, which is nearly equivalent to the current number of observations. We deploy our deep learning methodology on existing MR observations, including the recent data from NICER, to infer the neutron star EoS. The reconstructed EoS band is consistent with conventional nuclear EoS models. We further demonstrate that our results are congruous with the bounds on tidal deformability obtained from the gravitational wave event, GW170817.

Present via

Offline

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