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AI-Driven Modeling and Inference in Gravitational Wave Astronomy

The growing capabilities of ground- and space-based GW detectors demand advanced tools for signal detection, waveform modeling, and parameter estimation. AI, particularly deep learning, offers powerful solutions. Physics-Informed Neural Networks (PINNs) embed physical laws into neural networks for consistent waveform generation and inverse modeling without large datasets. Normalizing Flows enable fast, flexible Bayesian inference of complex posteriors. This report highlights recent progress in applying these methods to GW science, emphasizing their role in real-time modeling and inference—paving the way for AI-driven, multi-messenger astrophysics.

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