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Solving Einstein's Equations within Holography with Physics Informed Neural Networks

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Holography (or the gauge/gravity correspondence) refers to the dual description of the same phenomena through two seemingly different theories: quantum field theory in four dimensions ("our world") and gravity in five dimensions. In some regimes, holography gives us a map to solve within one of the descriptions (classical Einstein gravity in 5D Anti-de-Sitter spacetime) something that is very difficult to tackle in the other (some strongly coupled quantum field theory) with our current techniques. This map can be extremely difficult to establish; in our case, it involves solving non-linear equations with inverse nature, something that traditional numerical methods are not able to do. I will present a new approach based on machine learning techniques, where a neural network is trained to solve these equations. Specifically, we use PINNs (Physics-Informed-Neural-Networks), in which the equations are embedded in the neural network structure itself.

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