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APPROXIMATION OF SOUND PROPAGATION BY NEURAL NETWORK | EUGENE

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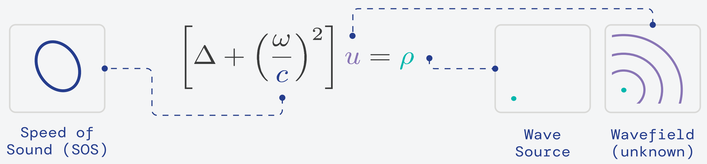
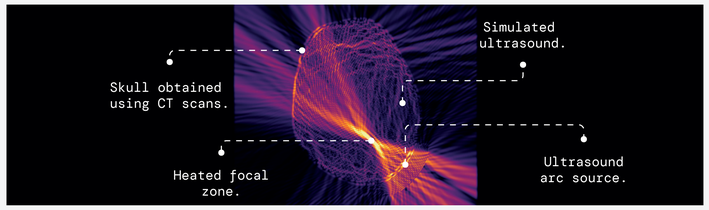
OBJECTIVE

§1.1 Solve Helmholtz Equation



§1.2 Why?

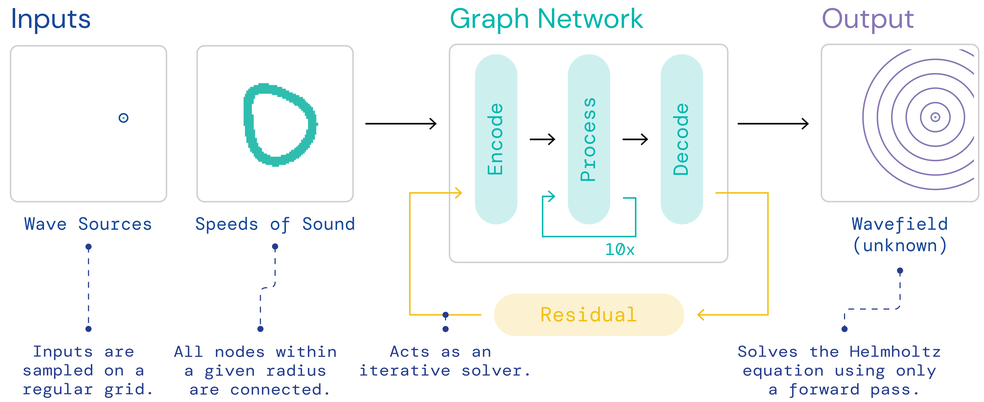
The transcranial ultrasound therapy is a non-invasive procedure, which can be used the **treatment** of **essential tremor**, **Parkinson's disease**, **Alzheimer's disease** and **brain tumor**.



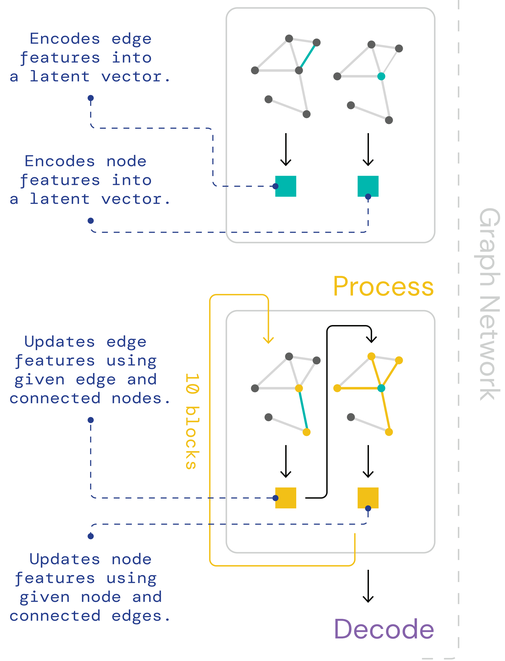
The ultrasound transmitter positioning requires a simulation of the ultrasound propagation through a skull – modeled by the **Helmholtz equation**. Traditional solvers requires a lot of computational resources. Thus, **a neural solver** is used to **reduce** the simulation **time**.

PROPOSED SOLUTION

§2.1 Model Scheme



§2.2 Graph Network Scheme



§2.3 Summary

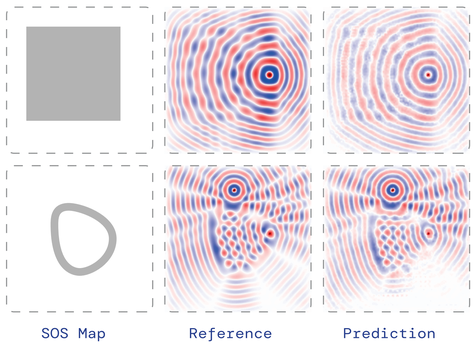
We proposed a novel iterative solver based on the graph neural networks capable of solving the Helmholtz equation. Even though our model was only trained on samples with a single source, it can predict a wavefield with **multiple sources**. Additionally, our model can perform an inference in the **512 × 512** computational domain, although it was only trained in the 96 × 96 domain. Also, we outlined the problem of training an effective model on an irregular grid.

Additionally, our model is capable of predicting a wavefield with the **downsampled derivative**. With this setting, the accuracy barely drops compared to the k-Wave solver. To the best of our knowledge, our method is the only PDE solver capable of working with just three points per wavelength.

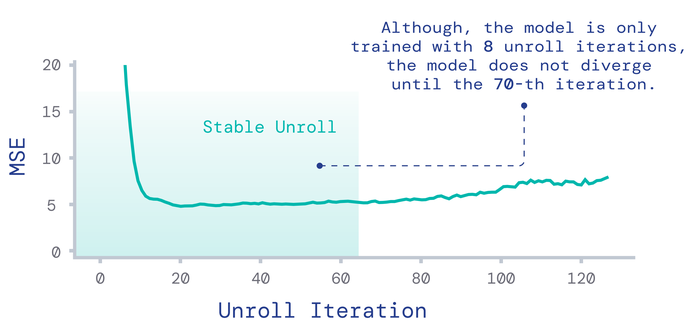
RESULTS

§3.1 Generalization

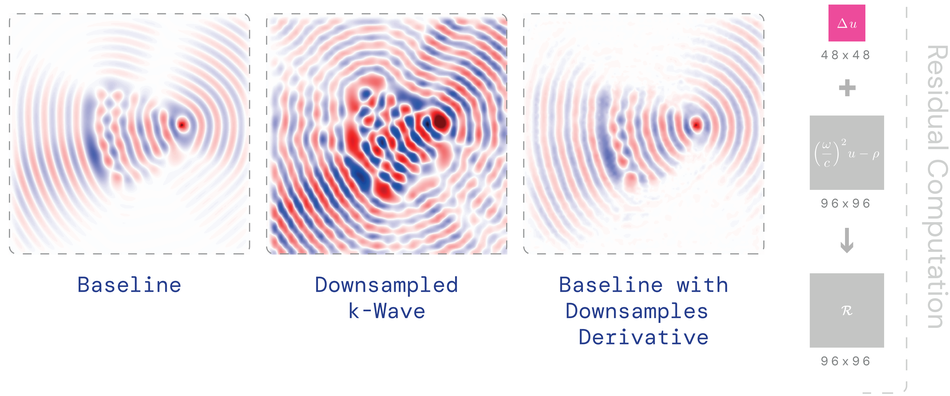
Model was **trained** only on the data **with a single wave-source**.



§3.2 Unroll Stability



§3.3 Downsampled Derivative



This work was supported by the Ministry of Education, Youth and Sports of the Czech Republic through the e-INFRA CZ (ID:90140).