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Enhancing Ring Laser Gyroscope data analysis through Neural Networks for Earthquake detection and Phenomenon identification

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This work focuses on creating two neural networks to optimize the analysis of data from ring laser gyroscopes, as in the case of the GINGER experiment at Gran Sasso. The Gingerino prototype provides data for deriving Earth's rotation, polar motion, earthquake detection, and distinguishing rotational components of tides. However, offline analysis using the Hilbert transform takes about 10 minutes. Therefore, our aims are: first, reconstructing the frequency from a sinusoidal signal using only 50 points, corresponding to one hundredth of a second in our case, with a precision of one-thousandth of a Hz, matching the target for seismological studies; and second, identifying the type of data.

The first neural network aims to provide data with minimal delays and sufficient precision to detect earthquakes. It achieves this by simulating sinusoids at different frequencies and adding noise to train the network to recognize different combinations corresponding to the same frequency.

The second network learns to recognize various phenomena in the data, such as earthquakes or transients from laser dynamics like split modes or mode jumps. These capabilities are realized through the automated labeling of data using neural networks and the implementation of a mask that facilitates the selection of high-quality data. The curated dataset can then undergo traditional offline analysis.

Collaboration

Role of Submitter

I am the presenter

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