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Studies from Los Alamos National Laboratory Describe New Findings in Machine Learning (Machine Learning Inference of Random Medium Properties)

2024 MAY 02 (NewsRx) -- By a News Reporter-Staff News Editor at Robotics & Machine Learning Daily News Daily News -- Investigators publish new report on Machine Learning. According to news reporting from Los Alamos, New Mexico, by NewsRx journalists, research stated, "Earth materials are heterogeneous across a range of spatial scales, but the resolvability of small structures is limited by data sparsity, noise, bandlimitedness and other difficulties. In practice, heterogeneities below a certain size cannot be recovered except through statistical medium descriptions, which even then can be difficult to uniquely determine."

Financial support for this research came from Laboratory Directed Research and Development (LDRD).

The news correspondents obtained a quote from the research from Los Alamos National Laboratory, "To improve the characterization of such heterogeneities, we develop a novel supervised machine learning model that provides insight about the recoverability of statistical medium properties from elastic waveform data and succeeds despite cycle-skipping and other challenges well known from elastic waveform inversion. We demonstrate the approach using random media generated by superimposing self-affine random variations on homogeneous and layered background structures. After training on sparsely-recorded, high-frequency waveforms from thousands of different random medium realizations, we show the machine learning model's ability to recover correlation lengths and other medium properties of interest to near-surface and crustal seismology, among other fields. For frequency passbands and spatial offsets encountered in seismology, Gaussian correlation lengths and the amplitude of the random variations relative to the background model are recovered even in challenging scenarios involving unknown medium parameters, complex crustal structures, and low signal-to-noise ratio. In comparison, von K árm án correlation lengths, which are related to larger-wavelength variations of the medium than Gaussian correlation lengths, are not as well recovered."

According to the news reporters, the research concluded: "These results provide one of the first and most systematic investigations of the recoverability of statistical properties of heterogeneities below the resolution limit of deterministic seismic tomography, and suggest practical machine learning strategies for high-frequency waveform seismology."

This research has been peer-reviewed.

For more information on this research see: Machine Learning Inference of Random Medium Properties. IEEE Transactions on Geoscience and Remote Sensing, 2024;62. IEEE Transactions on Geoscience and Remote Sensing can be contacted at: Ieee-inst Electrical Electronics Engineers Inc, 445 Hoes Lane, Piscataway, NJ 08855-4141, USA. (Institute of Electrical and Electronics Engineers - www.ieee.org/; IEEE Transactions on Geoscience and Remote Sensing - ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=36)

Our news journalists report that additional information may be obtained by contacting Kai Gao, Los Alamos National Laboratory, Earth and Environmental Sciences Division, Los Alamos, NM 87545, United States.

The direct object identifier (DOI) for that additional information is: https://doi.org/10.1109/TGRS.2024.3367541. This DOI is a link to an online electronic document that is either free or for purchase, and can be your direct source for a journal article and its citation.

Keywords for this news article include: Los Alamos, New Mexico, United States, North and Central America, Cyborgs, Emerging Technologies, Machine Learning, Los Alamos National Laboratory.

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