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Integrating Machine Learning and GIS for Improved Seismic Hazard Assessment in Urban Areas

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In 2020, natural disasters impacted approximately 100 million people globally, underscoring the critical need for enhanced risk assessment and preparedness, particularly in densely populated urban areas prone to seismic events like Lisbon. Despite comprehensive seismic risk models for Lisbon, there is a notable gap in user-friendly, real-time tools for assessing earthquake impacts and implementing effective evacuation plans. This study aims to address this gap by developing a 3D web-GIS platform that provides dynamic, real-time visualisations of urban vulnerabilities to earthquakes, incorporating 3D building models to enhance risk communication and support effective response strategies. The platform will assist decision-making for policymakers, urban planners, and national civil protection agencies by offering detailed visualisations of potential earthquake impacts and facilitating the coordination of emergency response efforts.

The study began with a comprehensive literature review to evaluate existing seismic hazard models, identifying their weaknesses and strengths to assess the potential need to develop more robust models for urban seismic risk assessment. To obtain site-specific information, diverse data types were collected, including remote sensing imagery, geological data, and topographical data. The current debate about the advantages and limitations of both Probabilistic and Deterministic Seismic Hazard Assessment methodologies led us to attempt to utilise GIS and machine learning techniques, such as neural networks, decision trees, and support vector machines, to evaluate the seismic hazard more effectively. To the best of our knowledge, integrating these techniques for Lisbon's seismic hazard assessment is an unexplored alternative.

Keywords: Seismic Risk Assessment, Seismic Hazard Models, Machine Learning Techniques