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Artificial Intelligence for the amelioration of seismic resilience of bridges

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ABSTRACT

Bridges are vital infrastructure connecting cities and other critical infrastructures. Thus, the assessment of seismic resilience is decisive in keeping the functionality of bridge infrastructure and helping their quick recovery during strong earthquakes. This article focuses on enhancing bridge resilience by the best drift ratio estimation while considering seismic ground motion mainly attributed to the wave passage, loss of coherence, and different local soil conditions. To do this, we adopt an artificial intelligence approach. However, there are several machine-learning algorithms (MLA); and the choice came back difficult. Here, we follow the roadmap given by (Boumédiène Derras & Makhoul, 2022), which offers the best MLA suited to analyze a bridge's seismic resilience. Firstly, a dataset is created. This dataset contains the metadata (explanatory factors), such as earthquake magnitude (M), Ground-Motion Intensity Measures (IM), soil class, and parameters of structures, such as displacement ductility capacity as well as drift ratio (target). The finest model needs to characterize well the drift ratio. The value of the drift ratio, predicted in this work, gives us the bridge's performance level (PL). This PL allows the classifying of infrastructure resilience.

Keywords: Artificial intelligence; seismic bridge resilience; magnitude; drift ratio.

1 INTRODUCTION

Resilience is the aptitudes of structures, infrastructures, systems, etc., to appropriately accommodate abrupt events and chronic stressors (e.g., earthquakes, tsunamis, flooding, climate change, etc.). Those aptitudes are: 1) planning and preparing before sudden events or recurring stressors; 2) absorbing the hazard consequences; 3) efficiently reacting to the event disruption by efficiently utilizing the available resources; 4) rapidly recovering and reinstating the functionality of the infrastructure, etc.; 5) adapting to the condition variations and remembering the lessons learned or future advancement. Numerous resilience assessment procedures to deal with extreme and natural hazards were suggested: 1) quantitative methods ((Bruneau et al., 2003), (Rose, 2007) and (Alderson et al., 2015)), and 2) qualitative or semi-quantitative assessments ((Fisher & Norman, 2010), and (Pettit et al., 2010)). Furthermore, deterministic and probabilistic techniques are offered for different levels (i.e., components, systems, networks, infrastructure, and a system of systems).

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