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Long-Term bearing displacement estimation model using artificial neural network and Bayesian optimization

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ABSTRACT

Bridges are exposed to adverse external environmental conditions causing long-term temperature-induced deformation significantly greater than traffic loading. The long-term bridge deformation is partially accommodated by sliding bridge bearings. The degradation of bearings can restrict the free longitudinal movement due to change in environmental conditions and thus threatens the serviceability and structural safety of the long span bridges. Accurate and reliable bearing response estimation due to change in diurnal and seasonal environmental conditions (ambient temperature and solar radiation) can support the robust early warning system for bridge bearings by detecting anomalies in real time. Traditional physics-based models for bearing response estimation are resource extensive, computational costly and undermine the estimation accuracy due to approximations made during the modeling process. To overcome this limitation, data-driven model is required for accurate and robust real-time bearing response estimation. This research proposes artificial neural network (ANN) with Bayesian optimization for long-term longitudinal bearing displacement estimation dominated by the daily periodic behavior of environmental conditions which also results in cyclic seasonal (annual) variation. The long span bridge of total length 6345 meters equipped with displacement monitoring and temperature sensors is utilized to validate robustness and effectiveness of the proposed methodology.

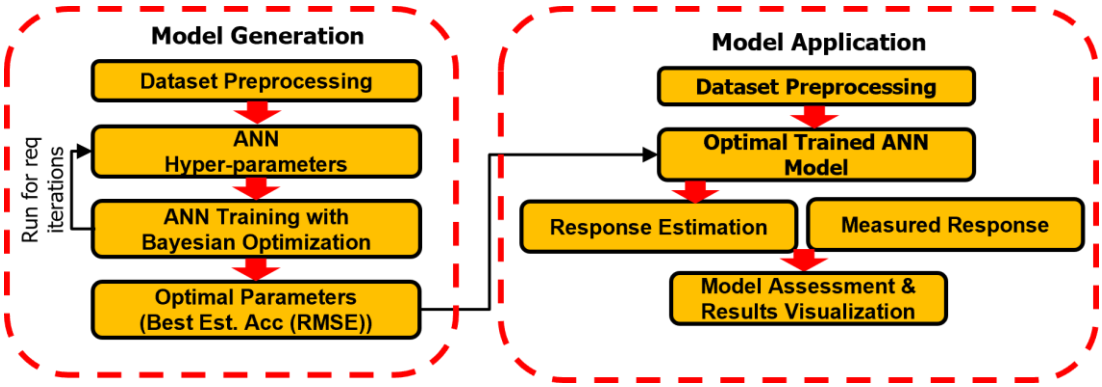

Fig. 1 Overview of Proposed Methodology

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