A Deep Reinforcement Learning-Based Method For Structural Failure Modes Searching

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In the research of structural safety, the dominant failure modes of a structural system are significant for structural analysis and failure probability estimation. However, due to the complexity of a structural system, existing failure modes searching methods often face problems caused by combinatorial explosion. To address this issue, a deep reinforcement learning-based searching method is proposed. The probability-based failure component selection process is transformed into a sequential decision process. The status information of different failure stages and the corresponding selected failure components are transformed to be the states and the actions. A deep neural network is established as an observer of the failure stages and select failure components. To guide the network to learn the failure component selection policy, a new reward function is designed in the training process. To avoid the local optimum problem and improve the training efficiency of the network, a self-play strategy is adopted in the training process to ensure that the failure component selection policy could be learned by the network. The trained deep neural network could observe the failure stages and select the most critical components of a structural system.