Deep learning-based named entity recognition from construction safety regulations for automated field compliance checking

Xiyu Wang[1] and Nora El-Gohary, A.M.ASCE[2]

[1]Graduate Student, Dept. of Civil and Environmental Engineering, Univ. of Illinois at Urbana-Champaign, 205 North Mathews Ave., Urbana, IL 61801. E-mail: xiyuw2@illinois.edu
[2]Associate Professor, Dept. of Civil and Environmental Engineering, Univ. of Illinois at Urbana-Champaign, 205 North Mathews Ave., Urbana, IL 61801. E-mail: gohary@illinois.edu

ABSTRACT

Automated safety compliance checking aims to detect field violations to construction safety regulations. Recent research and system development efforts have made good progress on automated tracking of labor and equipment towards improved violation detection and safety compliance. However, extracting and modeling safety requirements for supporting automated violation detection or safety alert systems remains highly manual. Towards addressing this gap, information extraction provides an opportunity to automatically extract safety requirements from regulatory documents for comparisons with field information to detect violations. However, existing information extraction methods fall short in their scalability and/or accuracy. To address this need, this paper proposes a deep learning-based information extraction method for extracting entities that describe fall protection requirements from construction safety regulations for supporting automated field compliance checking. The proposed method uses a hybrid bidirectional long short-term memory (BiLSTM) and convolutional neural network (CNN) model for recognizing the entities. The proposed method was implemented and tested on four selected Occupational Safety and Health Administration (OSHA) sections related to fall protection. It has achieved an average precision, recall, and F-1 measure of 81.5%, 80.3%, and 80.9%, respectively, which indicates good named entity recognition performance. The paper discusses the proposed method and experimental results, and outlines directions for further performance improvement.