Behavior recognition method for construction workers based on accelerometers: The case of steel bar workers

Dongcheng Zhang, Maoshan Qiang, Hanchen Jiang

(Institute of Project Management and Construction Technology,
State Key Laboratory of Hydroscience and Engineering, Tsinghua University, Beijing 100084)

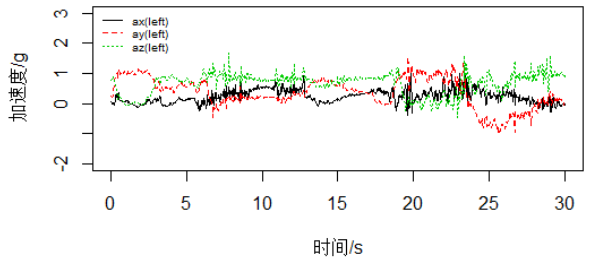
Extended Abstract: Recognizing construction workers' behavior automatically is the core method of real-time management of quality, safety and efficiency in construction. It requires cross-integration of many areas such as construction, information and management. Taking steel benders as an example, acceleration data in wrists of ironworkers is collected with accelerometers in the construction process. The device, as shown in Figure 1, looks just like a watch that can be easily wearable without disrupting normal working activities.

Figure 1 accelerometer device used for experiments

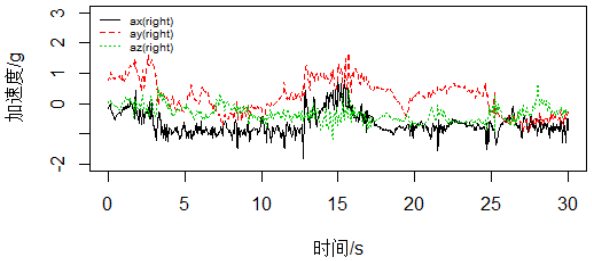
Five proficient workers voluntarily participated in the experiment and offer to wear the device on their both wrists during working time. In parallel to the accelerometer data, the activities of the workers were also recorded through videos, which provided the ground truth on the workers' actual behaviors (as shown in the example in Figure 2). Specific to the work type of steel bar workers, all activities are classified into three categories, including fetching steel bars, tying steel bars and non-work activities.

Figure 2 the video recording of the steel bar workers on construction site

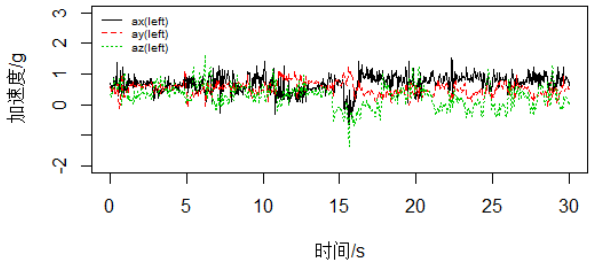
The acceleration data collected during different activities show strong patterns that can be used for activity identification, as shown in **Figure 3a-f**.



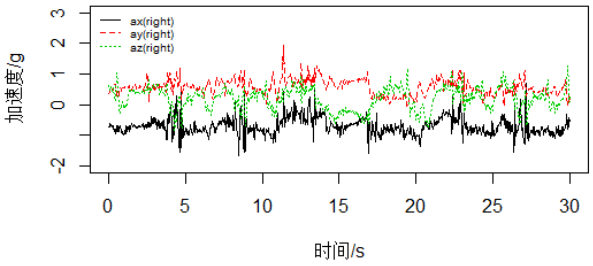
(a) example of data from the major hand when fetching steel bars (30s interval)



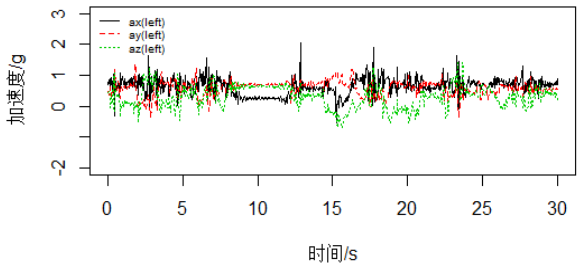
(b) example of data from the minor hand when fetching steel bars (30s interval)



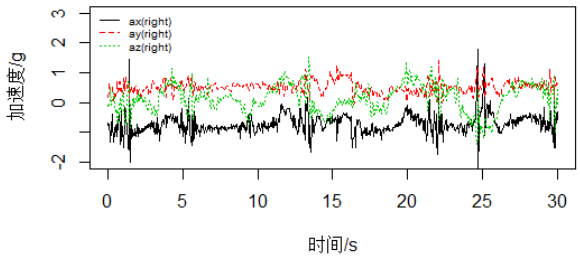
(c) example of data from the major hand when tying steel bars (30s interval)



(d) example of data from the minor hand when tying steel bars (30s interval)



(e) example of data from the major hand during non-working activities (30s interval)



(f) example of data from the minor hand during non-working activities (30s interval)

Figure 3 Example acceleration data collected during different activities

Using Fast-Fourier Transformation (FFT), we extracted features from acceleration, and then

trained classifiers for activity classification. Based on the comparison of multiple alternative classifiers, the best classifier and features are selected. The experiments demonstrate that the best features are connected with the data segment length; within a certain range, the longer the data segments are, the higher the recognition accuracy is; and recognition accuracy is up to 85.9%, higher than previous studies with a more detailed classification of steel benders' behavior. The paper provides a method for the recognition of typical workers' behavior on site, and establishes a foundation for the automated real-time monitoring of construction workers, and management of construction quality, safety and efficiency.