Summary: Using automatic skeleton generation to extract the movement of body during the suggested clinical immobilization test

**Introduction**: Based on the previous study on the annotation of Restless legs syndrome (RLS) video record, developing an algorithm for automatic skeleton generation can standardize the annotation, extract more features, and visualize torso posture that may not be identified in the previous study. Using the OpenPose, a real-time automatic skeleton generation system, we developed an algorithm to detect the movements of body and extract relative feature.

**Method**: OpenPose is used to extract the 2D-coordination of 25 body parts for each frame in the SCIT video record. The head part is selected to analyze the performance of method.

(A) The movement is detected based on the **velocity**. The velocity of each body parts in each frame is computed by the difference of 2D-coordinations between the current frame and the next frame under Butterworth filter. The movement will be detected when the velocity of body parts exceeds a configured threshold.

(B) The movement is detected based on the **velocity using five-points stencil**. The velocity of each body parts in each frame is computed by the difference of 2D-coordinations between the current frame and the next 4 frames. The movement will be detected when the velocity of body parts exceeds a configured threshold.

(C) The movement is detected based on the **magnitudes**. The magnitudes of the movement of each body parts in each frame are computed by the maximum of the difference of 2D-coordinations between the current frame and the next 30 frames. The movement will be detected when the magnitude of body parts exceeds a configured threshold.

Based on the given handwritten annotation, the precision and recall rate for each method and each research assistants can be calculated by using different thresholds of velocity to detect a movement.

**Result**: In the different threshold, the sensitivity and precision of 3 methods are calculated based on 5 research assistants’ annotation to create ROC curve. The average area under the ROC curve is used to define the performance of algorithm. (A) avg AUC: 0.469 (B) AUC: 0.233 (C) AUC: 0.611

**Conclusion**: The magnitude method has higher performance than the velocity method on detecting the movement. The noisy of velocity method is relatively higher than other method and it does not perform with a high precision. This significant noisy may be caused by the noisy of OpenPose, which may generate the 2D-coordination with the fluctuation around few pixels. To analyze the performance of algorithm based on the clinicians and experts’ agreement will be the next step in our research. This algorithm may significantly increase the efficiency of the annotation of RLS video record to enhance the big data set of behavioral annotation.