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. OpenPose is a real-time automatic skeleton generation system to jointly detect the human body, hand, facial, and foot keypoints (in total 135 key points) on single images. Using the OpenPose, the participants’ body skeleton on each frame in the SCIT video record can be extracted. Based on the body skeleton data, 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.

(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 start of movement will be detected when the velocity of body parts exceeds a configured threshold. The end of movement will be detected when all the velocity of body parts in 30 frames are below this threshold.

(B) The movement is detected based on the **velocity using 5 points stencils**. The velocity of each body parts in each frame is computed by 5 points stencils of the difference of 2D-coordinations between the current frame and the next 4 frames. The start of movement will be detected when the velocity of body parts exceeds a configured threshold. The end of movement will be detected when all the velocity of body parts in 30 frames are below this 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 start of movement will be detected when the magnitude of body parts exceeds a configured threshold. The end of movement will be detected when all magnitudes of body parts in 30 frames are below this 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**:

**Conclusion**: