# *STUDYING UPPER-LIMB KINEMATICS USING INERTIAL SENSORS*

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AIM: The aim of this study was to analyze scapulohumeral rhythm through nine physical properties that correspond to angular mobility, angular velocity, and acceleration in the three axes of space, obtained by inertial sensors.
METHODS: This cross-sectional study recruited healthy young adult subjects. Descriptive and anthropometric independent variables related to age, gender, weight, size, and BMI were included. Nine physical properties were included corresponding to three dependent variables for each of three special axes: mobility angle (degrees), angular speed (degrees/second), and lineal acceleration (meters/seconds$^2$), which were obtained thought the inertial measurement sensors with four inertial sensors (*InertiaCube3™ Intersense Inc., Billerica, Massachusetts*). Inertial sensors were placed in the right half of the body of each subject located in the middle third of the humerus slightly posterior, in the middle third of the upper spine of the scapula, in the flat part of the sternum, and the distal surface of the ulna and radius.
RESULTS: Descriptive graphics of analytical tasks performed were obtained (figure 1). The main difference in mobility between the scapula and humerus was found in pitch axis for abduction ($\overline{X}$ = 107.6°, SD = 9.3°) and flexion ($\overline{X}$= 113.1°, SD = 9.3°).
CONCLUSION: This study shows how much each body segment contributes to upper-limb motion, and allows us to obtain grades of mobility provided by the scapula. Also, this study identified movement patterns, and supports inertial sensors as a useful device to analyze upper-limb kinematics. However, further studies with subjects with shoulder pathology should be carried out.

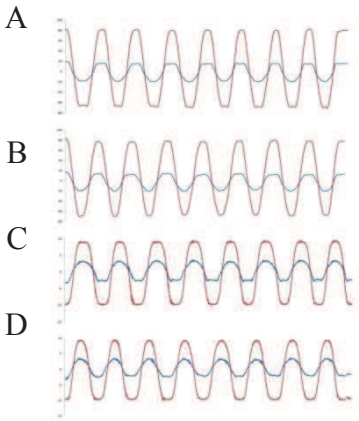


**Figure 1:** Four examples of kinematic patterns through reptitions were showed for angular mobility during flexion (A) and abduction (B), and the linear acceleration during flexion (C) and abduction (D) in pitch axis.

Humerus _____
Scapula_____