Analyzing UE range of 3D motion as a movement “cloud”
Lanie Gutierrez-Farewik, PhD, Assoc. Prof. of Biomechanics
KTH Royal Institute of Technology & Karolinska Institutet
Stockholm, Sweden lanie@kth.se

1. Motivation
   a. Objective assessment of overall UE reach
   b. Assessment of accessible volume, asymmetry, and treatment effect

2. Steps
   a. 3D motion analysis with markers on trunk and hand/arm (here: PIP3, MCP3, wrist, elbow)
   b. Guide patient in reaching around in all directions during motion tracking (here: growing circles starting with hand extended ipsilaterally, contralaterally, anteriorly, posteriorly, superiorly, inferiorly) See Fig. 1.
   c. Compute marker motion with respect to a chosen center (here: midpoint of C7 and mid-clavical points)
   d. Compute total volume of ‘cloud’ created by chosen upper extremity marker (shown here: PIP3)
   e. Compute volume of ‘cloud’ shape by sector (antero-ipsilateral-superior, antero-ipsilateral-inferior, etc.). See Fig. 2.
   f. Normalize volume by cubed arm length

3. Opportunities
   a. Assessment of targeted therapy for specific daily activities
   b. Assessment of compensatory movement efficacy

4. Preliminary findings
   a. Time-efficient (ca. 10 minutes)
   b. High intra- and inter-session reliability

Fig. 1: Tracked motion of (a) Left and (b) Right PIP3 markers, as seen from above, in a child with unilateral CP (left side affected).
Fig. 2: Illustrated volume cloud of a left PIP3 motion trial in a TD child, divided into sectors with respect to the trunk origin (midpoint of C7 and Clav markers). The red section illustrates the volume enclosed in the antero-ipsilatero-superior sector, the light blue indicates that of the postero-ipsilatero-inferior section, etc.