STATICALLY EQUIVALENT SERIAL CHAIN MODELING WITH KINECT AND WII BALANCE BOARD

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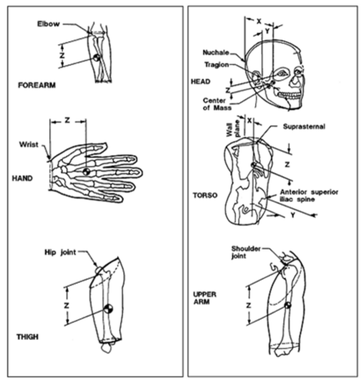
Introduction/Motivation

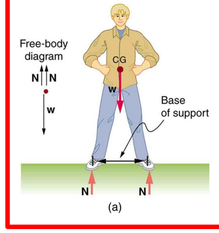
Identifying the center of mass location provides a significant aid in controlling the balance of humanoid robots. Additionally, in humans this location is an essential parameter in postural control and is critical in assessing rehabilitation and the mastery of sport skills.

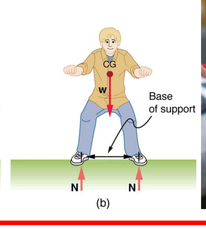
This research presents an estimation technique that uses the statically equivalent serial chain (SESC), a representation of any multilink branched chain whose end-effector locates the center of mass.

- Common methods:

1. Anthropometric tables but their accuracy is readily questioned.
2. Low-Pass Filter & Second Integral utilize force plate continuously and require the mass and the height of subject.





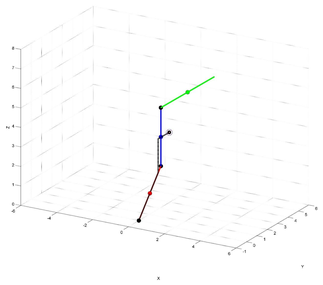


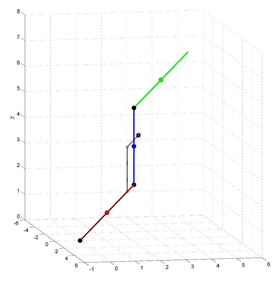
Methodology

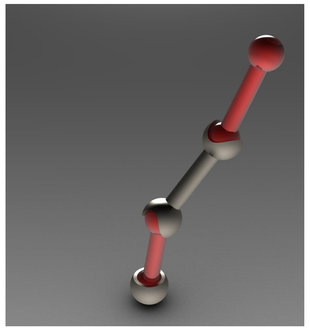
- **Statically equivalent serial chain**

$$\vec{C} = [\mathbf{B}_1\ \mathbf{B}_2\ \mathbf{B}_3] \begin{Bmatrix} \vec{s}_1 \\ \vec{s}_2 \\ \vec{s}_3 \end{Bmatrix}$$

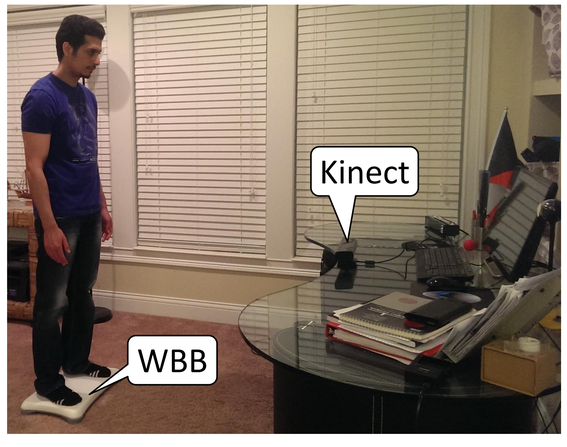
WBB: $\vec{C}$ — Kinect: $[\mathbf{B}_1\ \mathbf{B}_2\ \mathbf{B}_3]$ — SESC: $\begin{Bmatrix} \vec{s}_1 \\ \vec{s}_2 \\ \vec{s}_3 \end{Bmatrix}$

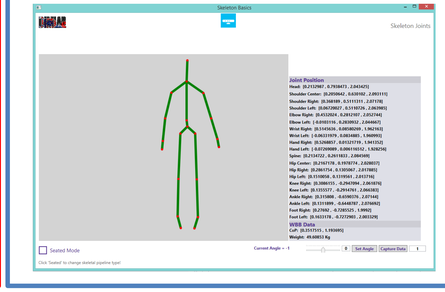


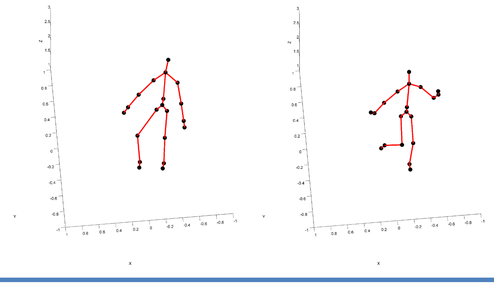




- **SESC construction**
  - To construct the SESC for center of mass prediction, a Kinect and Wii balance board are used.
  - The Xbox Kinect provides joint location information.
  - The Nintendo Wii balance board provides the center of pressure.







COP Versus COM

- Center of pressure is the point location of the vertical ground reaction force vector.
- Center of pressure and projection of the center of mass are the same for a static posture.

Conclusion

- The utility of the presented method as compared to other common methods is that the center of pressure, and hence, the Wii balance board, is no longer needed after the SESC is constructed.
- After constructing SESC center of mass can be estimated in real time motion by just using Xbox Kinect.
- Calculating the center of mass can prove critical to assessing rehabilitation success in pathology detection and in the mastery of sport skills.

Future work

- Using the new Xbox one Kinect to capture the motion.