A JOINTS ESTIMATION ALGORITHM FOR GUGT

Cippitelli E., Gasparrini S., Spinsante S., Gambi E. - Università Politecnica delle Marche
{e.cippitelli, s.gasparrini, s.spinsante, e.gambi}@univpm.it

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Abstract

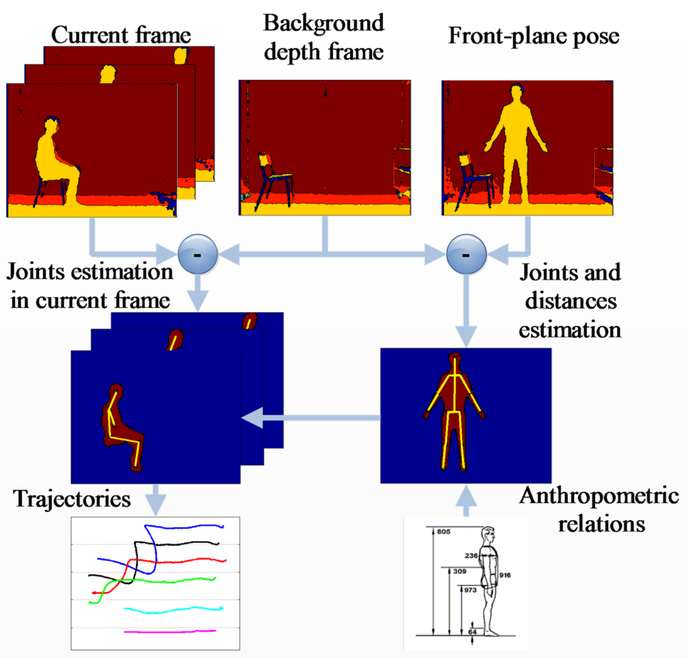
The "Get Up and Go Test" (GUGT) represents an assessment tool to evaluate elderly people gait and balance. This test is used in hospital environment, and consists in standing from an armless chair and starting to walk. It might be useful to design an automatic system which gives an objective (i.e. repeatable) score of the test, using the Microsoft Kinect sensor, which integrates depth and color cameras. We propose an innovative markerless solution, to estimate the trajectories of six side skeleton joints, for objective gait analysis. Anthropometric models, used to extract joints coordinates, avoid unnecessary resource-consuming computations and allow real time implementation.

Joints Estimation Algorithm for Get Up and Go Test

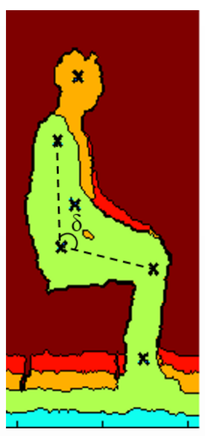
The algorithm works on raw depth data and the basic steps of the joint estimation tool are [1]:

- *construction of a background depth frame*, i.e. the setup scene without the subject;
- *analysis of the front-plane pose*: the subject stands in front of the sensor at a fixed distance to calculate distances between adjacent joints, based upon anthropometric models, that are used in the trajectory estimation phase;
- *trajectory estimation phase*: the patient performs the GUGT test, and the proposed system identifies and tracks the joints, at each frame captured.

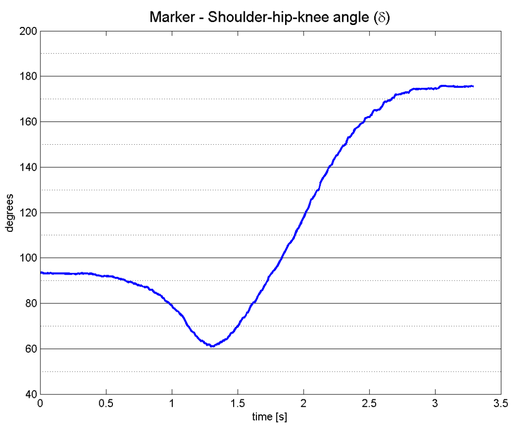
The system estimates x-y coordinates, inside the depth frame, of 6 left-side joints: head, shoulder, elbow, hip, knee and ankle.

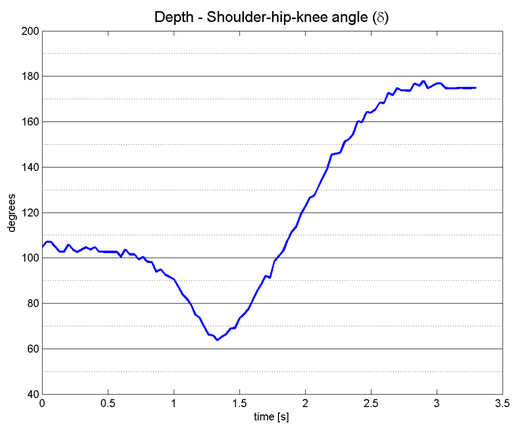


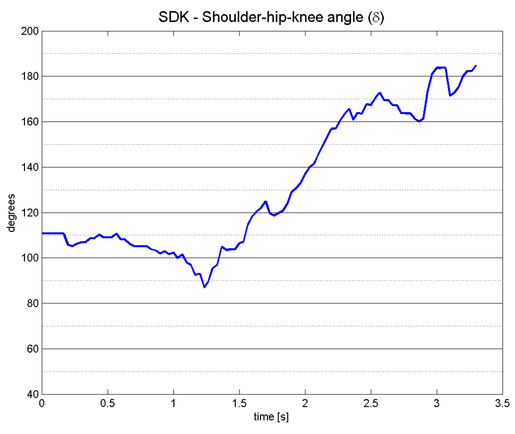
Performance Analysis

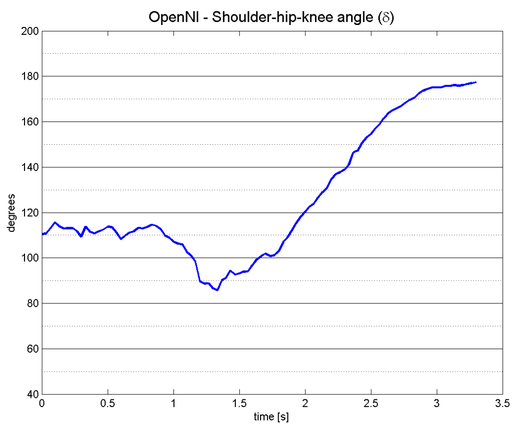


In order to evaluate the reliability of the proposed algorithm (*Depth*), the estimated joints coordinates should be compared with those obtained through other tracking systems. The joints positiones acquired by tracking the markers in a video-based system [2] (*Marker*) are considered as a reference, while the skeleton obtained through the Microsoft SDK 1.7 [3] (*Kinect*) and OpenNI 2.1 [4] (*OpenNI*) constitutes respectively a second and a third system, against which the algorithm developed can be compared.
A major index in the evaluation of the test is the angle δ between shoulder, hip and knee, which provides the inclination of the torso. The figures below show the trajectory of δ angle during the first phase of the test, called sit-to-stand. A preliminary qualitative assessment concludes that the proposed solution better approximates the real curve (*Marker*). Future works will concern the evaluation of significant parameters from the joints coordinates, to infer a posture estimation index for the GUGT.









References

[1] E., Cippitelli, S., Gasparrini, E., Gambi, S., Spinsante, A Depth-Based Joints Estimation Algorithm for Get Up and Go Test Using Kinect, in *Proc. IEEE International Conference on Consumer Electronics 2014*, Las Vegas, USA, pp. 228-229, Jan. 2014

[2] ELITE Clinic, BTS Engineering

[3] Kinect for Windows, Microsoft, `http://www.microsoft.com/en-us/kinectforwindows/`

[4] OpenNI, Primesense, `http://www.openni.org/`