Natural Arm Trajectory Generation for Brain-Controlled Prosthetics
J. Sovilla, R. Chavarriaga, J. del R. Millán

Introduction
These last years have seen important progress concerning brain-controlled arm prosthetics, both with invasive and non-invasive interfaces. However, independently of the method chosen for delivering the command, the prosthesis needs a model to re-create human-like trajectories. In this work, we compare three models for arm trajectory generation taken into account the characteristics of human natural movements.

Modeling Human Kinematics
- Need of a kinematic model in order to determine the reachable space and possible postures of the arm.
- 4 DoF arm Model
- Arm reachable space model
- Simulation of prosthetics
- Test of the model

Human Movements Vs. Generated Trajectories
- Models are compared to the actual human movements in order to choose the most human-like, with parameters chosen to comply with natural movements.
- Trajectories
- Speed Profile

Material
- Tracking of the position of the hand, elbow, and shoulder using an ultrasound tracker (Zebris).
- Point-to-points movements monitored on a referenced frame.
- 20 occurrences for 6 back and forth point-to-point movements were recorded with 10 subjects.

Trajectory Features
- Total Time
- Curvature
- Maximum Speed
- Velocity Profile

Selected Models
- Minimum Jerk Model [1]
  - Maximizes the smoothness of the speed
  - Straight trajectory
- F2REACH [2]
  - Control of the curvature
  - Statistical trajectory
- Multi-referential VITE [3]
  - Control of the Cartesian and the joint angle space
  - Whole arm trajectory generation

Conclusion and Future Work
- Among these models, the F2REACH model seems to be the best compromise for natural movements, between the curvature and the speed profile.
- Further work is being developed to analyze elbow position generation.
- The F2REACH model has several parameters that demands to be tuned, it thus needs further investigation from the user point-of-view in order to come up with a well-suited trajectory.

References

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