AUDI KONFUZIUS-INSTITUT INGOLSTADT

AKII Microlab

Technische Hochschule Ingolstadt

Bachelor/Master Thesis

Learning Inverse Kinematics for VR Avatars

Problem description

In VR systems head and hands controllers are critical for motion estimation in reliable avatar construction. Inverse kinematics calculations offer the possibility to calculate poses for arm joints and upper body out of controllers' positions. This data could be used for an improved avatar display. The problem of learning of inverse kinematics in VR avatars interactions is useful when the kinematics of the head or controllers are not accurately available, when Cartesian information is not available from camera coordinates, or when the computation complexity of analytical solutions becomes too high. The major obstacle in learning inverse kinematics is the fact that this representation has an infinite solution space. Thus the learning algorithm has to converge to a particular inverse and to make sure that this inverse is a valid solution. The project proposes a neural network learning approach for leaning the inverse kinematics mapping (i.e. the Jacobian). For the task of learning such a non-linear mapping among the combined position and joint angles to changes in joint angles (i.e. angular velocities) we investigate the use of a multi-layer deep neural network with a dedicated architecture capable of avoid kinematic singularities, using tracking data, which is always physically correct and will not demand impossible postures as can result from an ill-conditioned matrix inversion.

Tasks

- Investigate the basics of inverse kinematics calculation in VR systems.
- Investigate neural networks capabilities for function approximations.
- Design and implement a neural network learning system for Jacobian estimation.
- Test and evaluate the learnt mapping against ground truth (i.e. camera tracking system).

Required skills

Strong programming experience, mechanics and kinematics knowledge, basic VR technologies, machine learning and algorithms.

Preferred field of study

BA/MA Computer Science, BA/MA Mechatronics(Robotics)

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