KI DELTA LEARNING
Scalable AI for Automated Driving

Motion Capture-based Virtual Reality Co-Simulation

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Use-Case in KI Delta Learning

Many current simulation environments have very stiff and repetitive human animations. Using these unrealistic animations for model training, may cause wrong predictions and reduced accuracy of human poses on more realistic data.
Using motion capture (Fig. 1), more fluid and realistic animations can be generated. However, the virtual environment, that the animations will be used in, is not visible to the actor. Interactions with the entities of the virtual environment can only occur by the imagination of the actor, which results in imprecise and unaligned interactions of humans and sensory systems.

Figure 1: Normal motion capture actor (left), motion capture Environment (middle), Virtual Reality motion capture actor (right) (© Markus Rehmann, Reutlingen University)

Additionally, the recorded data might contain rare poses resulting in sparse data, which hinders the learning of any algorithm.

Technical Solution

To record scene-relevant animations, the actor needs to perceive the virtual environment. This is facilitated by using a Virtual Reality headset during motion capture recordings (Fig. 1).
The actor needs to see a body representation to allow for self-perception and immersion in the virtual environment, which improves reactions to and interactions with other entities in the scene even further. Usually, motion captured animations are recorded and later used in simulations. To allow the actor to see the virtual body animated by their current movements (Fig. 2), the motion capture data needs to be streamed in real-time to the

Figure 2: Co-Simulation outside view (left), Virtual Reality view (right) (© Markus Rehmann, Reutlingen University)

simulation.
Like other simulations, different types of ground truth data can be generated (RGB, depth, semantic segmentation, bounding boxes, 2D & 3D joints, meta data).
Additionally, this streamed pose data can also be used to detect rarely occurring poses with live anomaly detection.
Furthermore, the co-simulation is designed to facilitate randomization of various parameters to re-simulate visually different data. Which can be triggered externally e.g. by offline pose-based anomaly detection to supplement the generated dataset (Fig. 3).

Evaluation

Scene relevant data with realistic human poses and motion created with the co-simulation is used as a basis for the evaluation of human behavior learning with human pose estimation (Fig. 4) and action recognition. The simulated data is also used as a completely controllable source of data for anomaly detection approaches developed within the KI Delta Learning project to circumvent the need for massive amounts of real world training data and labeling.

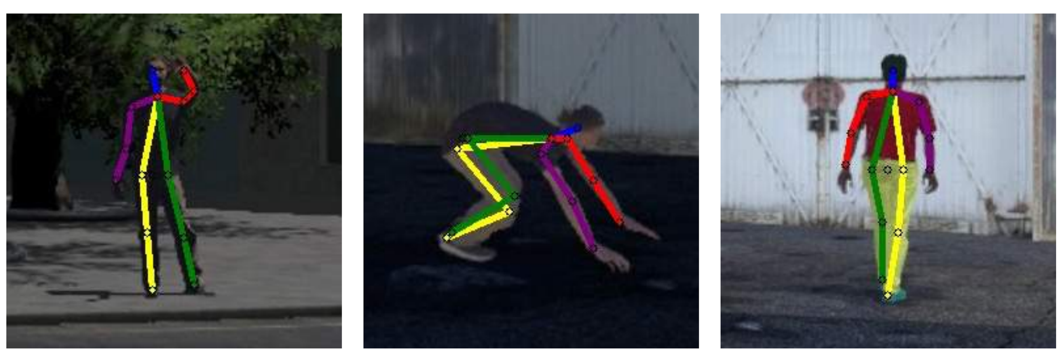

Figure 4: Evaluation with human pose estimation (© Markus Rehmann, Reutlingen University)

Figure 3: Visual randomization of lighting and colors of skin, clothing, objects (© Markus Rehmann, Reutlingen University)

Environment / Training Strategies

Partners

External partners

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