Developing Natural Full-body Motion Synthesis in Virtual Humans

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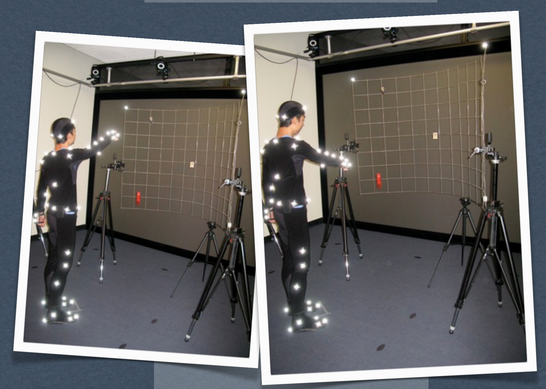
Background

- The system under development is a two-phase immersive virtual reality training program with interactive virtual human agents [1].
- The system uses realistic, parametrized gestures in various contexts.
- Phase I (modeling): Experts model needed gestures/actions via demonstration using motion capture hardware.
- Phase II (training): Captured motions are re-used to train apprentice users.

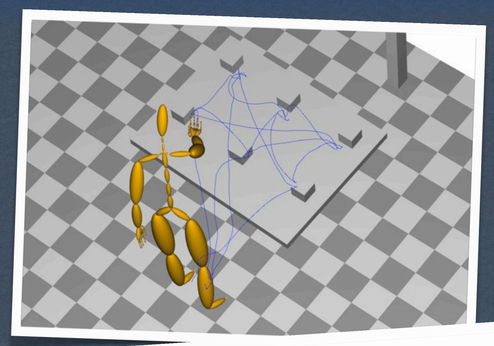
Motion Capture

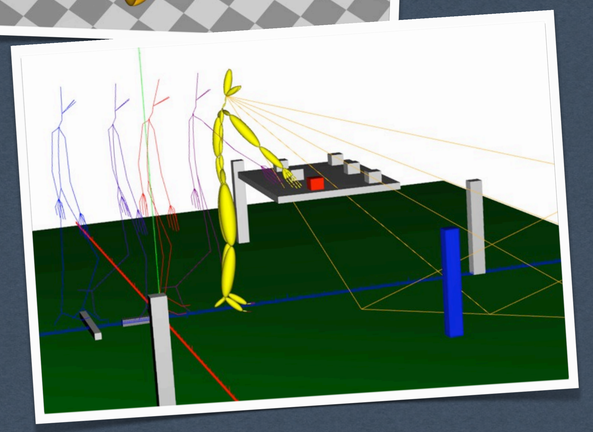
Horizontal Target Plane



Vertical Target Plane

Motion Analysis



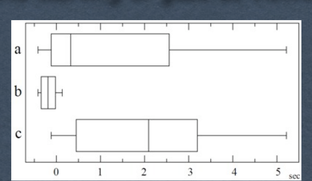


- Top: hand trajectory of captured pointing motion.
- Bottom: annotation application showing gaze phase-plane and reconstructed environment.

Study I – Gaze Model

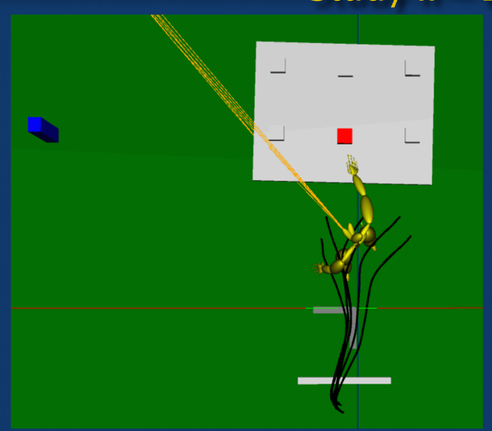
- Gaze behavior is an important non-verbal communication channel for effective full-body motion synthesis.
- We focus on analyzing gaze behaviors in demonstrative tasks.
- Time stamps of key gaze events are annotated.
- Temporal parameters of gaze behaviors are analyzed and modeled.

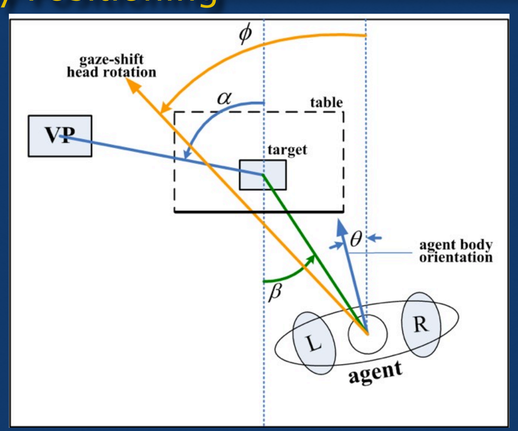
1. Temporal delay (Δt) between action stroke point and starting of gaze-at-viewer event.



2. Correlations between duration of gaze-at-viewer and viewer positions.
3. Gradual decline of gaze-at-viewer durations.

Study II – Body Positioning





α - relative standing location for the viewer in respect to target object

β - relative standing location for the agent in respect to target object

Θ - body orientation of the agent

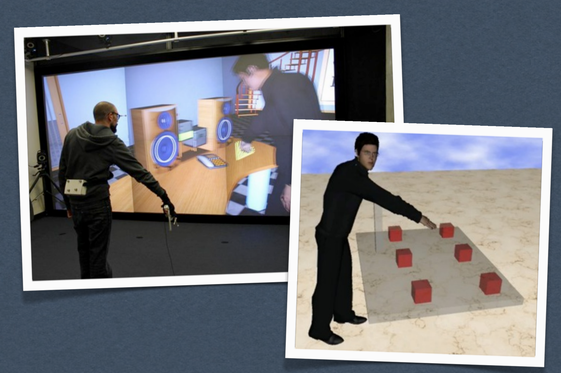
ϕ - maximum head rotation during gaze-at-viewer

Study III – Coordination

- Upper-body actions and gestures are parametrized with *Inverse Blending* [2].
- Lower-body walk and stepping sequence is generated with either Motion Graphs or a locomotion planner.
- The coordination of upper- and lower- motions is critical for generating human-like movements.
- The focus is on the short blending window at the end of locomotion and beginning of upper-body action/ gesture.

Action synthesis with realistic gaze behaviors

User Evaluation



- These early findings on gaze modeling, body positioning and locomotion-action coordination will inform the design and utility of interactive training and educational applications with virtual humans [3], and shape the future work in this domain.

[1] Interactive Motion Modeling and Parameterization by Direct Demonstration, C. Camporesi, Y. Huang and M. Kallmann, Intelligent Virtual Agents (IVA), 2010

[2] Motion Parameterization with Inverse Blending, Y. Huang and M. Kallmann, The Third International Conference on Motion in Games (MIG), 2010

[3] Gesture Variants and Cognitive Constraints for Interactive Virtual Reality Training Systems, S. Huette, Y. Huang, M. Kallmann, T. Matlock and J. L. Matthews, IUI 2011

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