The Virtual Human

"Heilmeier Catechism"

Human Systems Integration
Human Human Performance
Human Physiology
Human Simulation
Human Cognition
Human Health
What are you trying to do?

A virtual human model

Increase human performance through simulation

Quantifying and optimizing human biological, cognitive capabilities
Physical prototypes are costly:
- sustainability
- assembly
- maintenance
- fit & function
- operation
- human factors
- training

What are you trying to do?
• Introduce more rigor into human systems integration
• Improve human-to-machine interactions
• Reduce amount of physical prototypes
• Reduce time to market
• Allow virtual human to test early in the design cycle
Why?

First prototype, before production
- 15 years
- $2 Billion
Testing and evaluation requires significant human involvement
Can be done by a virtual human
How is it done today, and what are the limits of current practice?

- Computer human models are introductory
- Human digital models are developed for specific applications with significant limitations
- Current digital human models are not physics-based nor contain cognitive or biological fidelity
- Current digital models are not validated
- Current digital models are not realistic

Example current digital human model
- SIEMENS Jack
- Dassault Systemes
What is new in your approach and why do you think it will be successful?

What is new

• Modeling behavior and social aspects
• Physics-based predictive methods for simulation
• Mathematical modeling of interpretable dynamic, complex human social systems
• Integrated approach
  (physics, physiology, biomechanics, cognitive)
• Realistic, validated, and high fidelity

Why

- Rigorous methods for predictive human modeling have shown great potential
- Ingredients (pieces of the technology) have finally matured
- Significant data has been collected and can now be used to develop and validate modeling and simulation.
Who cares? If you succeed, what difference will it make?

• All branches of the military
• Any entity that is concerned with human performance and safety
• Any entity that desires to conduct tradeoff analysis involving humans
• Any entity that desires to test new equipment involving humans
Studies have shown reduction in cost & time because of modeling & simulation. If a physics-based cognitive and biological digital human model is created, it will result in a significant impact:

- Save Lives: The ability to use digital humans instead of humans in high risk environments
- Save Time: Reduce the amount of time by testing human factors digitally
- Save Cost: By decreasing the amount of physical prototypes needed
- Improved human-machine-interaction: By bringing the human into the loop during the design phase

Who cares? If you succeed, what difference will it make?

What are the risks?

Technical challenges
- Obtaining data for cognitive and biological models
- Human physics-based M&S
- Computational power for human simulation
- Fidelity needed
- Cost of validation
- Integration into one comprehensive virtual human

Cultural challenges: Disbelief in simulation results

How much will it cost?

Proposed Effort

2000  2005  2010

2018  2020  2022  2024  2026  2028

Estimates: $20-30 Million

How long will it take?

Already developed

Rudimentary digital human models

Physiological modeling
Cognitive data, models, & artificial intelligence
Psycho-social modeling
Modeling of interpretable dynamic, complex human social systems
Experimental data collection & analysis
Verification and validation
Integration of models into one
What are the mid-term and final “exams” to check for success?

- Ability to use a digital human model to reduce number of design prototypes
- Ability to use a digital human model to improve human performance
- Reduction of cost and time in the design of large military systems
- Ability to use digital human models to reduce risk
- Ability to use digital human models to conduct cognitive studies, trade-off analysis.
Thank you

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