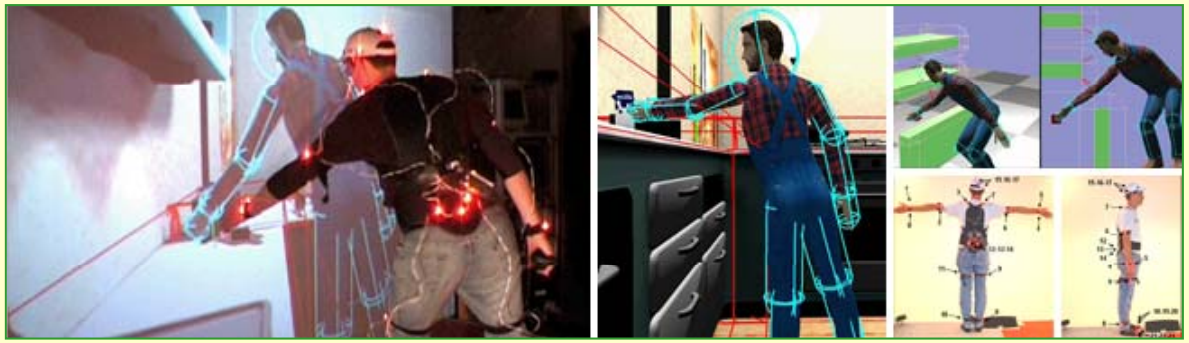
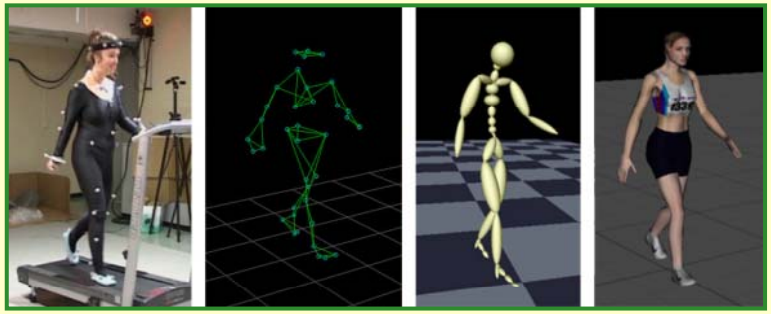
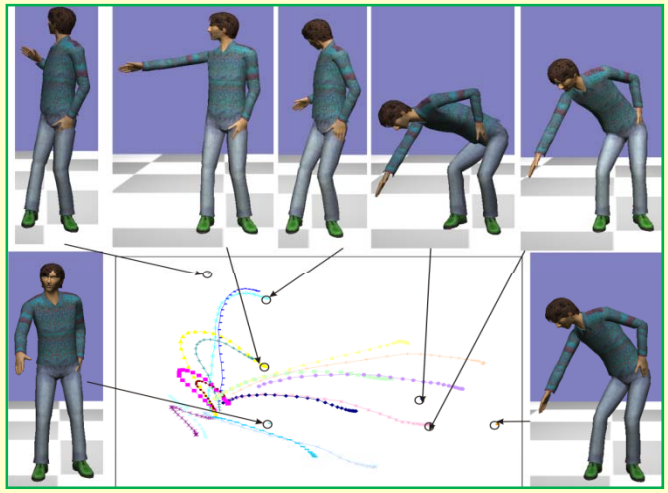


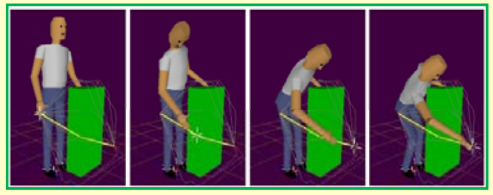
ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Immersive
Interaction
Group

IIG







EPFL is one of the two Swiss Federal Institutes of Technology. With the status of a national school since 1969, the young engineering school has grown in many dimensions, to the extent of becoming one of the most famous European institutions of science and technology.

Core data: 11'000 persons on campus, including 8'500 students (Ba, Ms, PhD), 350 labs

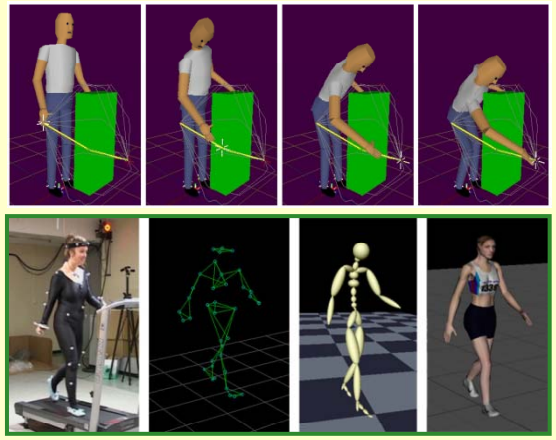
The Virtual Reality Laboratory (VRLAB) was founded in July 1988 by Prof. D. Thalmann. The laboratory participated to 37 european projects (STREP, IP, NoE) and 13 national projects.
Dr R. Boulic was hired on December 1989 ; on February 2011 he founded the research group in Immersive Interactions (IIG) after the VRLAB closed due to the retirement of Prof. Thalmann.

Immersive Interaction Group

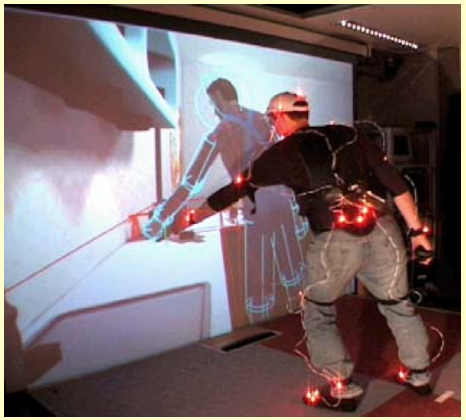
The Immersive Interaction Group (IIG) is led by Dr Ronan Boulic. We are currently involved in the EU IP project ***Cyberemotions*** and 3 national SNF projects: Synergia ***AerialCrowds***, ***Interactive Optimization of Mobile Articulated Structures***, and ***Embodied Interactions***.

Virtual Mannequin and Situated Interactions expertise

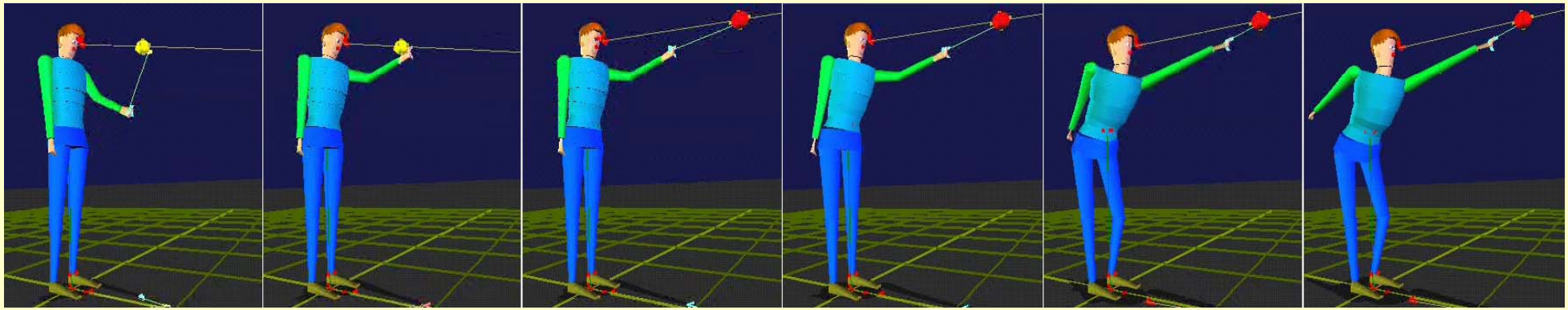
- Virtual Mannequin (VM): confering autonomy to virtual humans in their interaction with their environment
  - ~ *Algorithmic framework for real-time postural control*
  - ~ *Integrates collision avoidance*
  - ~ *Data-based motion models: full-body reach, locomotion*



- Situated interactions for Virtual Prototyping
  - ~ *Embodied interactions with real-time full-body motion capture*
  - ~ *Versatile embodiment of target population*
    - The person responsible to evaluate a virtual prototype should be able to intuitively control a large range of potential users



Virtual Mannequin (1): Priorities among a set of reach, gaze and balance tasks.



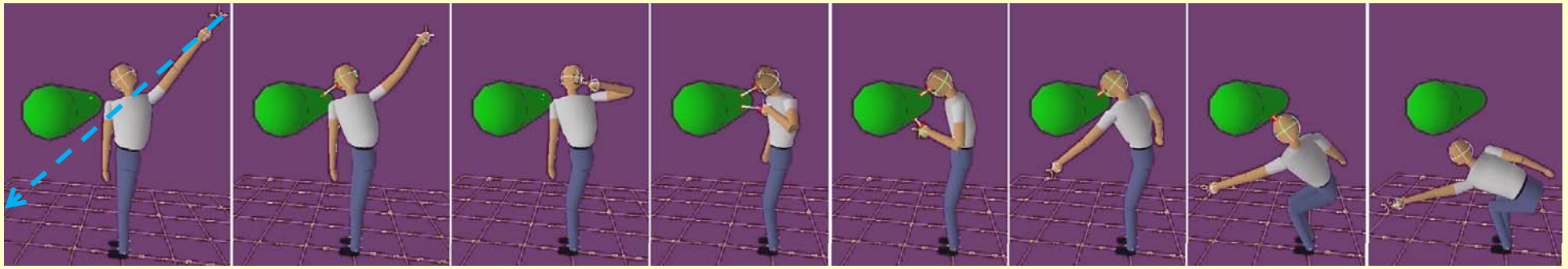
a b c d e f

The left hand has to reach a (yellow/red) target and the mannequin has to continuously look at the target while keeping the feet on the ground and maintaining balance.

Our framework allows the integration of ***multiple levels of strict priority*** *among tasks*, i.e. the balance task must always be enforced whereas the reach task is only enforced as much as possible after balance is ensured (c-f). The tasks decoupling is ensured with projection operators in real-time [BB04].

[BB04] P. Baerlocher, R. Boulic, « An Inverse Kinematic Architecture Enforcing an Arbitrary Number of Strict Priority Levels », The Visual Computer, Springer Verlag, 20(6), 2004, pp 402-417

Virtual Mannequin (2): collision avoidance through damped displacements.



a b c d e f g h

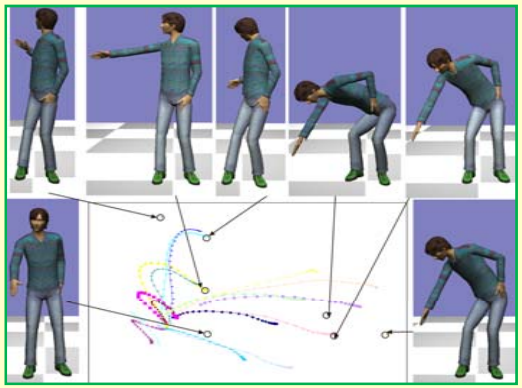
The left hand has to reach a mobile target moving along the dashed blue line and the Virtual Mannequin has to continuously look at the mobile target

Collision avoidance is ensured through ***temporary damped displacement tasks*** when some body parts move towards nearby obstacles (visualized as line segments in d-g).

Our framework allows priority levels to ***dynamically change during the convergence*** to accomodate to the risk level, i.e. the damping task priority increases as the body part is getting closer to the obstacle [PMMRDB09].

[PMMRDB09] M. Peinado, D. Meziat, D. Maupu, D. Raunhardt, D. Thalmann, R. Boulic, Full-Body Avatar Control with Environment Awareness, in IEEE Computer Graphics and Applications, vol. 29, p. 62-75, 2009.

Virtual Mannequin (3): combining with data-based synergies.



a

b

c

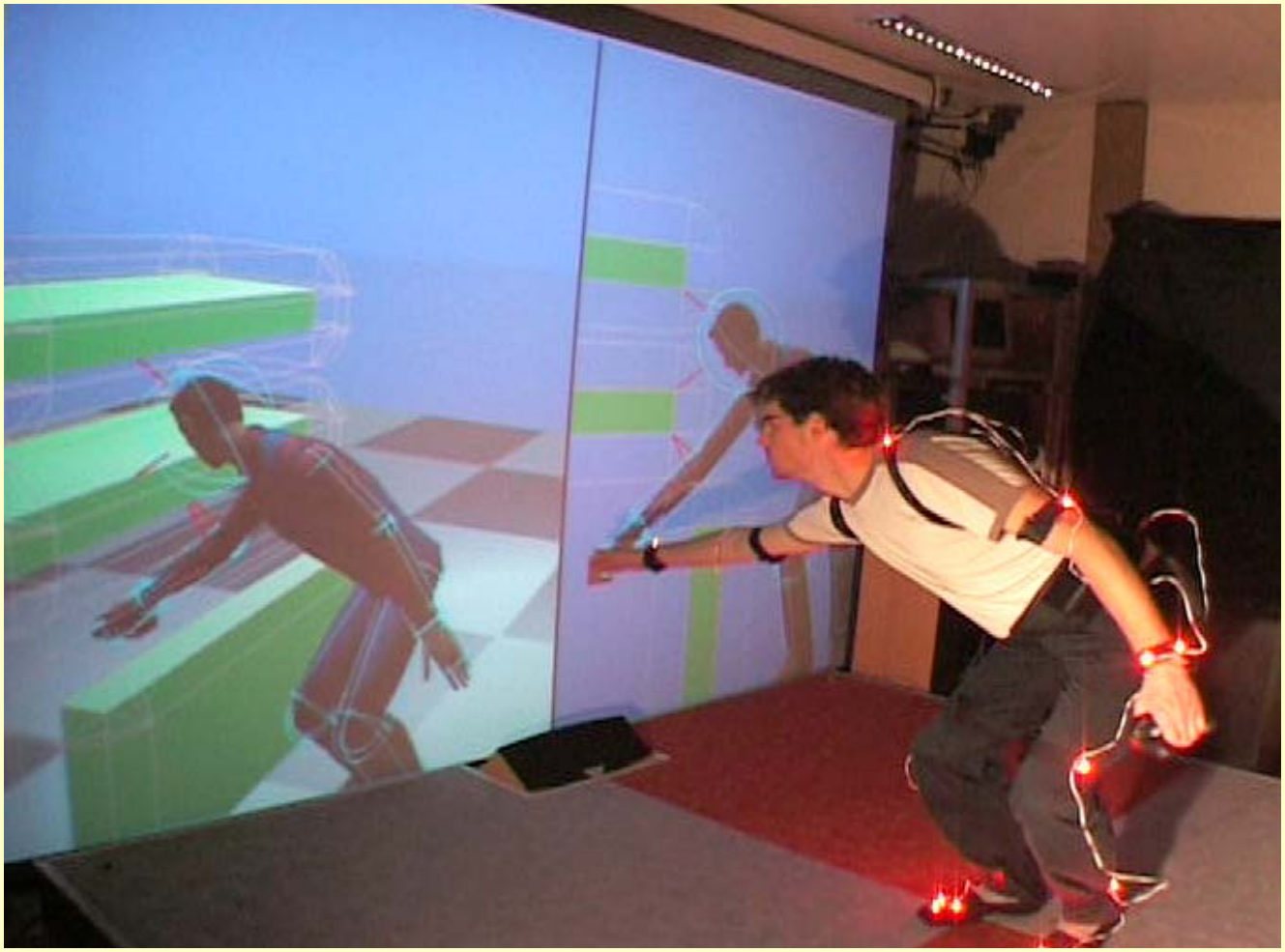
Captured motion dabases (a) allow to build normalized motion models for the full body applicable to the full spectrum of Virtual Mannequins (b).

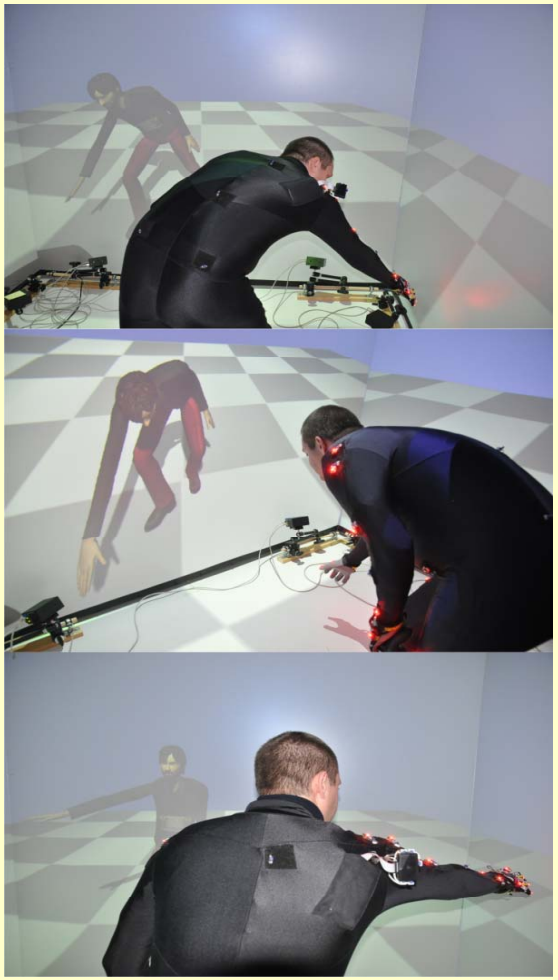
Our framework can integrate such rich information as a task guiding the convergence while being associated with a priority level too [RB09]. For example the left hand orientation task (maintaining the bottle vertical in Fig c) is given a higher priority than the data-based reach task of the right hand. However, the data-based reach task will be achieved as much as possible without perturbating the orientation task.

[RB09] D. Raunhardt,R. Boulic, Motion constraint, The Visual Computer 25:509-518 (2009).

Situated interactions for Virtual Prototyping (1)

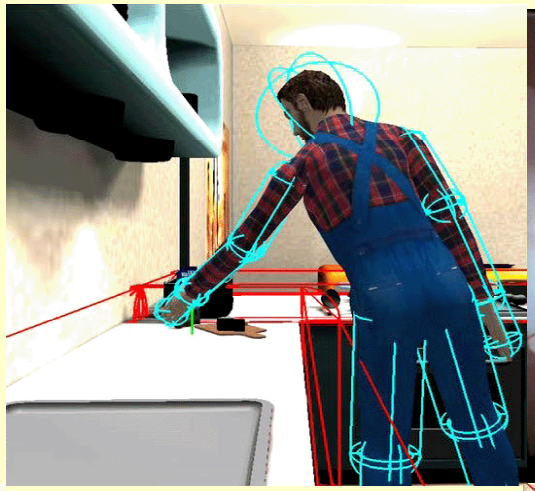
Embodied interactions with large screen or CAVE with full-body motion capture.

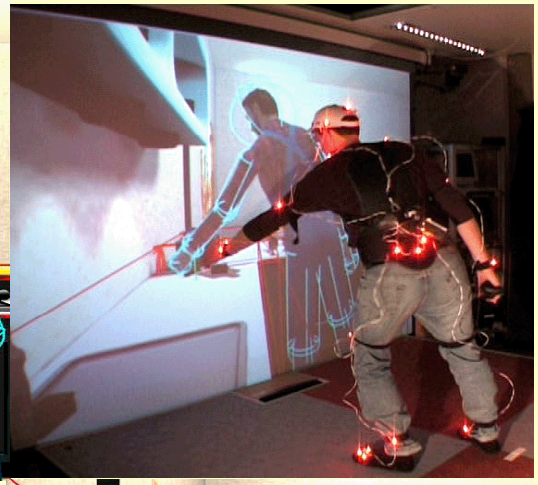


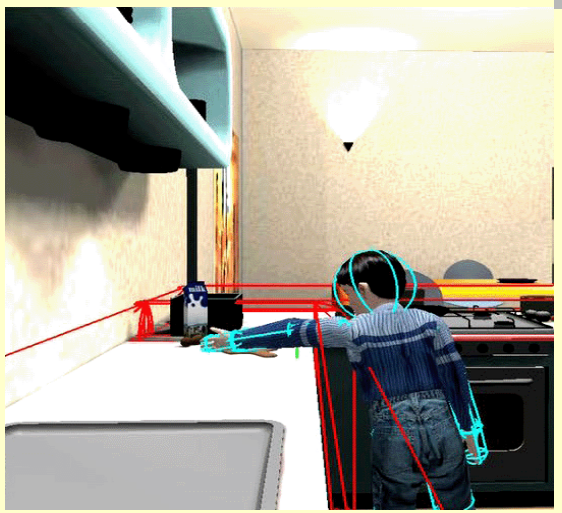


Situated interactions for Virtual Prototyping (2)

Versatile embodiment of target population; at what scale should the virtual environment be displayed :
- User scale (visuocentric) ?
- Target scale (egocentric) ?



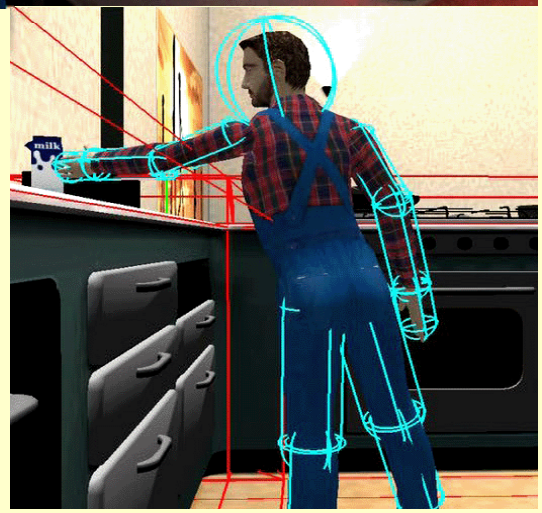




Visuocentric strategy

Scenario :

Move according to a child's perception of space



Egocentric strategy

R. Boulic, D Maupu, D Thalmann, On Scaling Strategies for the Full Body Interaction with Virtual Mannequins, Journal Interacting with Computers, 21(1-2), 11:25 (2009)

Virtual Mannequin and Situated Interactions future work

- Algorithmic
  - fast posture reconstruction in cluttered virtual environments
  - Combining multiple statistical models of human actions and behaviors based on motion captured data
- Immersive embodied interactions
  - Assess new types of immersion and scene display to optimally exploit CPU-GPU resources. Collaboration with cognitive neuroscience lab.
  - Exploit full-body input for intuitive evaluation of complex environments
  - Other applications: rehabilitation, treatment of phobia, …