

M. van Diest<sup>1</sup>, C.J.C Lamoth<sup>2</sup>, J. Stegenga<sup>1</sup>, G.J. Verkerke<sup>3</sup>, K. Postema<sup>4</sup>

(1) INCAS<sup>3</sup>, Assen, (2) Center for Human Movement Sciences, (3) Department of Biomedical Engineering, (4) Department of Rehabilitation Medicine, University Medical Centre Groningen, University of Groningen, the Netherlands

### Objective

Realizing a training platform that enables elderly to train their balance at home to reduce fall incidence. **Serious games** are developed to disturb balance, a **sensor system** is developed to quantify balance.

### Background

#### Falls in the Netherlands

1/3 of healthy 65+ population falls at least once a year<sup>1</sup>

140.000 elderly medically treated

32.000 hospital admittances

15.000 hip fractures (25% disability)

M€ 400/year

### Contributors



INCAS<sup>3</sup> is a research institute seeking to advance scientific and technological knowledge in the field of sensors and sensor systems.

Gameship is a studio specialized in gaming & entertainment and houses high-end equipment in the fields of motion capture, 3D rendering, audio and video.

### Correspondence

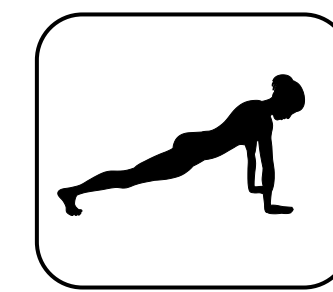
mikevandiest@incas3.eu

## Ph.D. Project Proposal

### System Requirements

#### Training aspects

Several intervention studies show that Multiple-component group exercises, Tai-Chi, and challenging balance exercises can reduce the rate of falls<sup>2</sup>. A literature study will be performed to elucidate which aspects exactly should be trained.



#### Balance assessment methods

Balance control is being assessed using a broad variety of methods including functional balance measurements (e.g. Berg Balance Scale), posturography and accelerometry (in combination with stochastic dynamics). Parameters that are being measured include the **centre of mass (COM)**, the **centre of pressure (COP)**, EMG, joint moments, joint angles and related measures (e.g. area/velocity covered by COP).<sup>3</sup> Based on the selected training aspects, **suitable parameters** are selected or developed.

#### Gameplay

In order to motivate the user, the training should be **enjoyable**. Elderly will be consulted about their likings. **Social interaction** with other users will be implemented.

### Development Sensor system and Serious Game

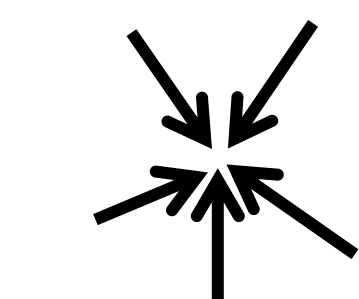
#### Development of the Serious Game

The training aspects that are defined are transferred to a **serious game**, of which the game concept is developed in partnership with GameShip. Important game features include fun, effectiveness and personalization. The game will be **effective** for users with a variety in postural control skills and is motivating because it is **fun** to play. The use of serious gaming in a **social context** specifically aimed at elderly is studied and implemented. Possibilities include score sharing or playing a training simultaneously, either offline or online.



#### Development of the Sensor System

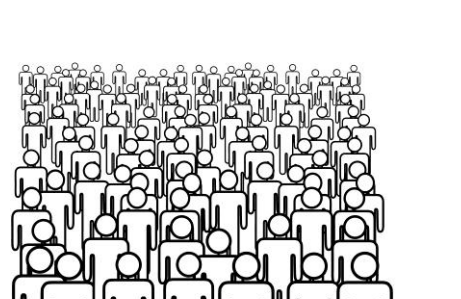
The sensor system is used to **quantify postural control** and it is integrated with the serious game. Possibilities for measuring balance are provided in the "Balance Quantification/Sensors" box. The types of sensors that are used depend on the training and on the outcome of the literature study. The sensor data is **fused** and compared with a **norm**, which has to be determined: What is a healthy 'amount' of postural control?



Fused Sensor data

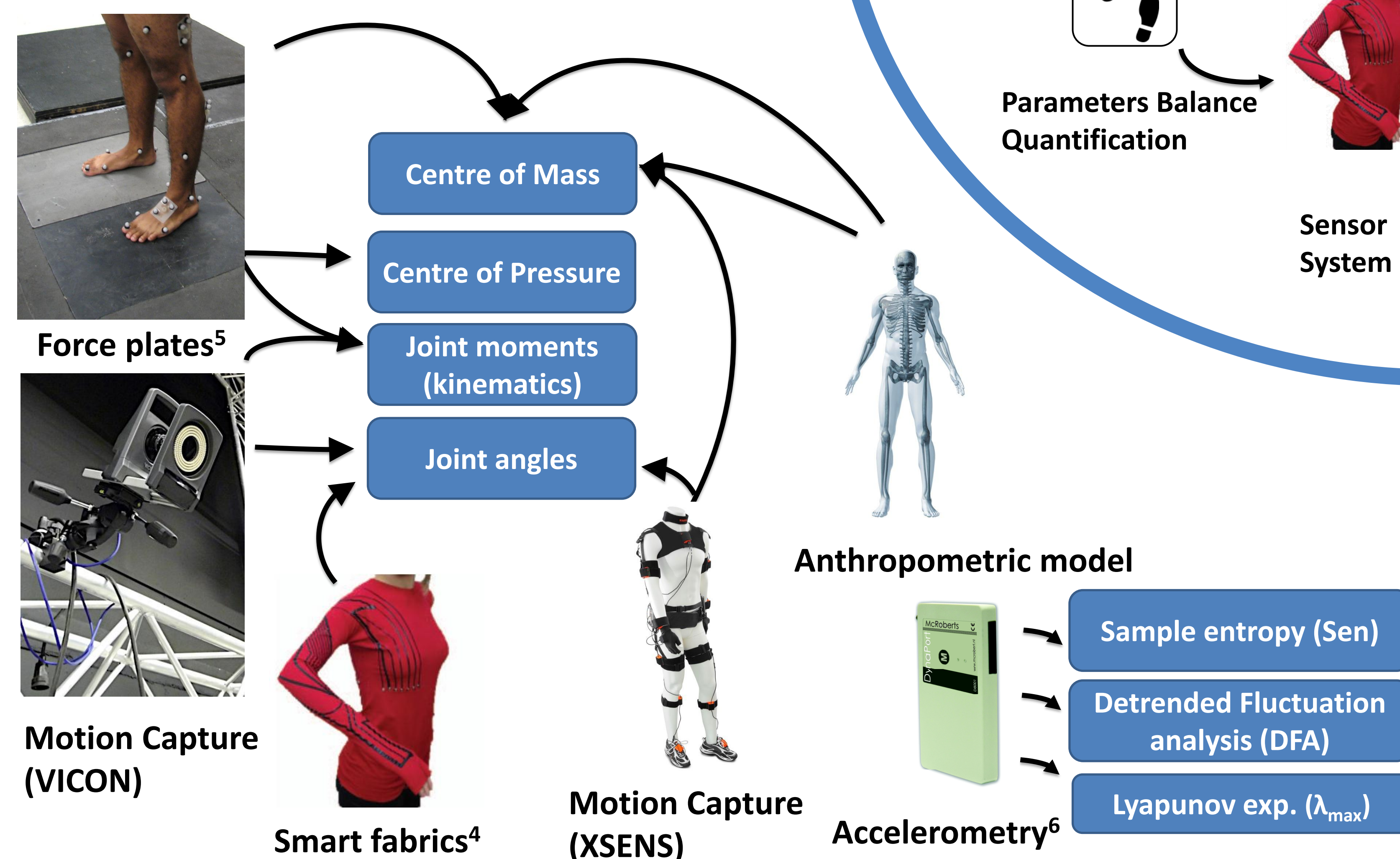


Balance assessment



Norm data

### Balance Quantification and Sensors



### Prototype and Studies

#### Prototype

A prototype consisting of a **serious game** and a **sensor System** will be developed and tested. The balance quantification method is validated using conventional instruments for measuring balance.

#### Feedback

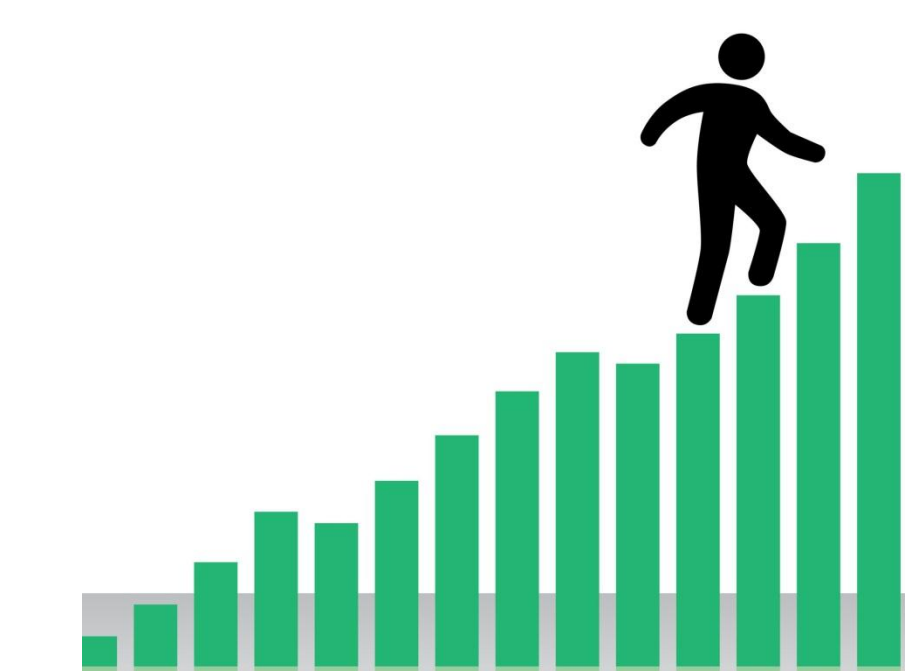
After analyzing the sensor data, feedback is generated to several entities.

- The **game platform** has to receive constant input from the sensor system to enable interaction between the game and the user.
- The **user** receives feedback from the game, which informs and motivates the user.
- Feedback related to the progression of the user could be sent to a **physician**. **Privacy** however has to be taken into account. The user is in control of his data.

#### Studies



Validation experiments



Effect study

### References

1 M.E. Tinetti et al. "Risk factors for falls among elderly persons living in the community." *The New England journal of medicine*, 1988  
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4 A. Tognetti, D. De Rossi et al. "Wearable kinesthetic system for capturing and classifying upper limb gesture in post-stroke rehabilitation." *J. Neuroeng. Rehab.*, 2005

5 D. Gordon E. Robertson, <http://commons.wikimedia.org>  
6 McRoberts, Dynaport MiniMod

### Acknowledgement

