

Human equilibrium augmentation in an exoskeleton using IMUs

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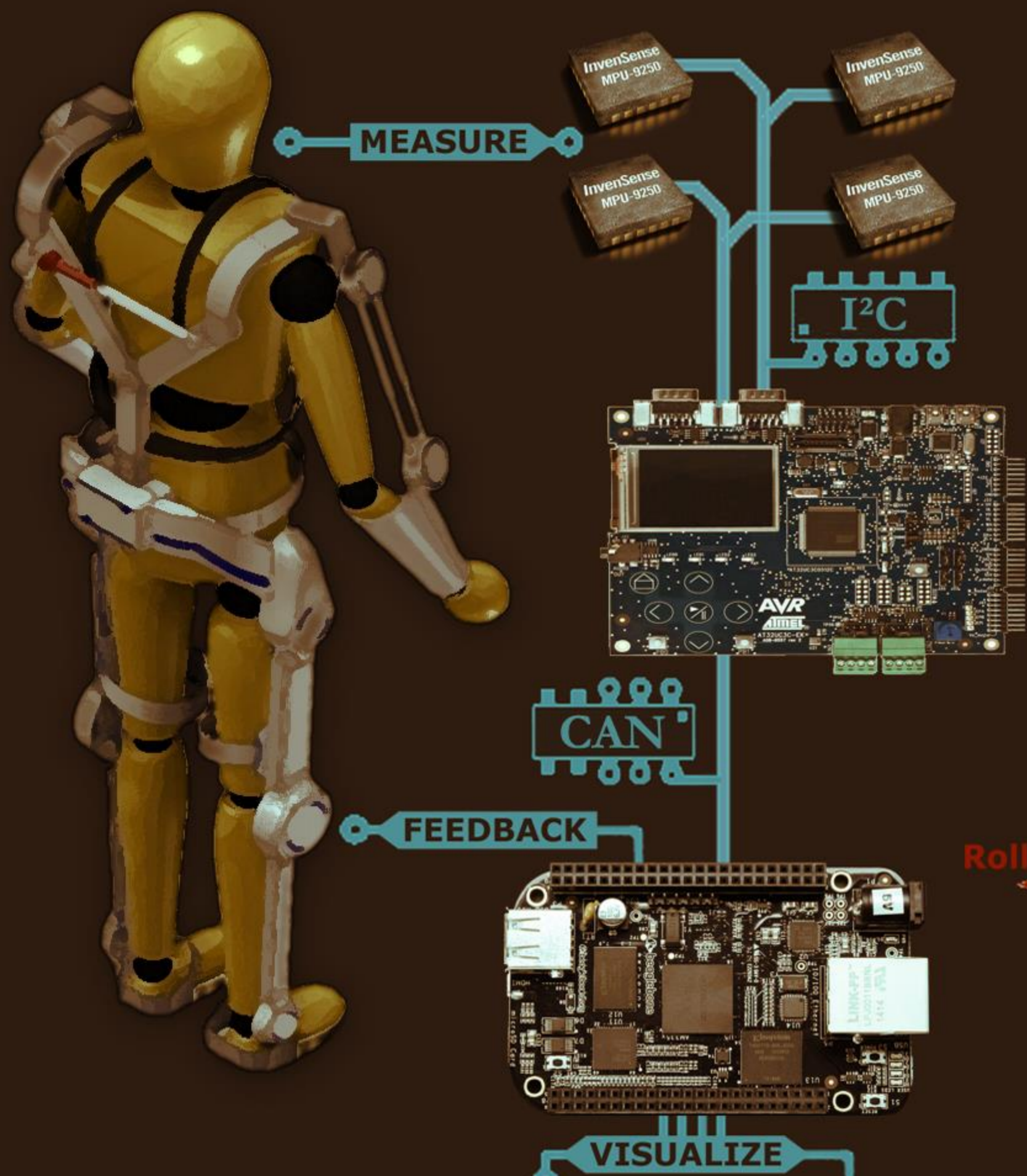
Objectives

The exoskeleton gives automated assistance to improve the equilibrium of the exoskeleton and its user



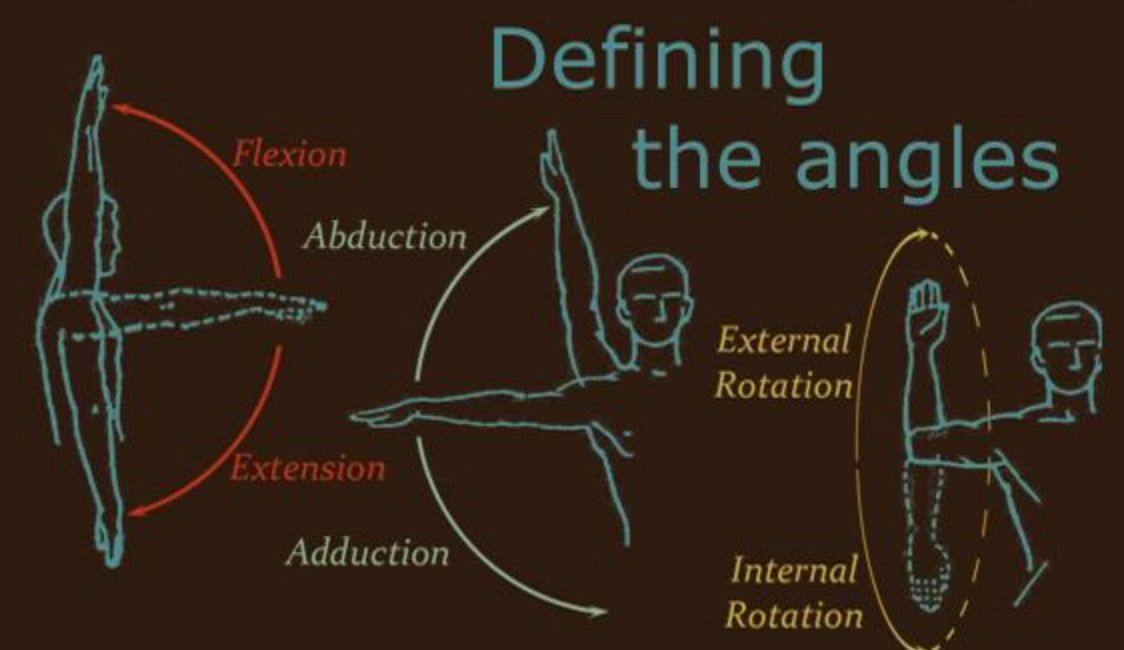
Materials and Methods

IMUs as Wearable Orientation sensors



Human body kinematics?

IMU requirements?



Estimating Orientation

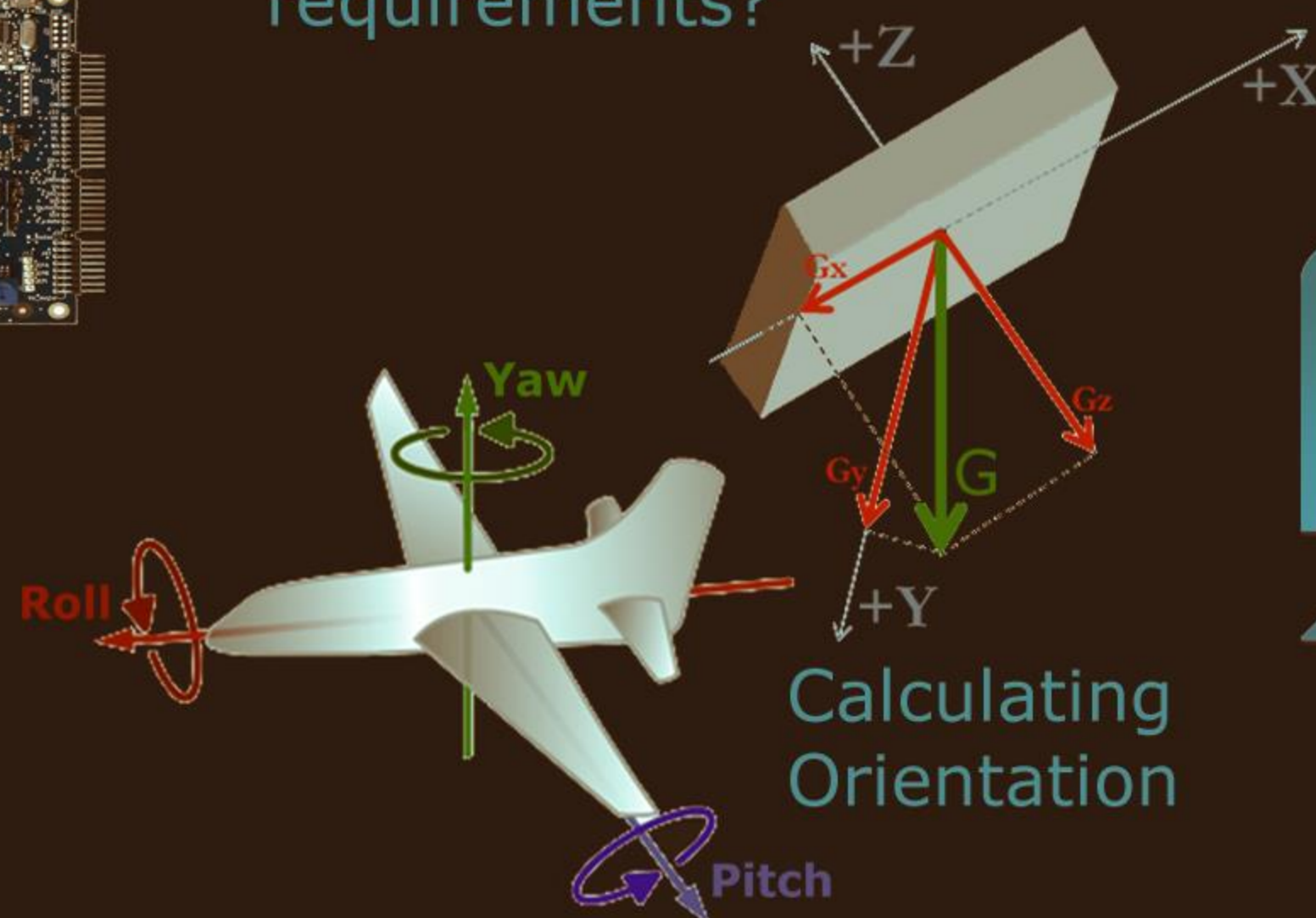
Time Update:

- Predict the State
- Predict the Error Covariance

KALMAN FILTER

Measurement Update:

- Calculate Kalman Gain
- Update State with Measurement
- Update Error Covariance



Results & Conclusion

- IMU and communication protocol are selected
- Self-tests, calibrations and setup stage are realized
- Sensor data is captured and forwarded to BBB
- BBB collects, processes and analyses data
- Analysed data is represented in an algorithmic structure and visualized in for human interpretation.

IMU 0		IMU 1	
x-as:	0.333252	x-as:	0.123779
Accelerometer y--:	-0.088867	Accelerometer y--:	0.170898
z-as:	0.903320	z-as:	-0.748047
x-as:	0.014914	x-as:	-0.036219
Gyroscope y-as:	-0.010653	Gyroscope y-as:	-0.038882
z-as:	0.018109	z-as:	0.055394
x-as:	19.921875	x-as:	55.517578
Magnetometer y--:	66.064453	Magnetometer y--:	18.164952
z-as:	-1.904297	z-as:	15.673828
Roll:	-5.62	Roll:	167.13
Measured Pitch:	-20.16	Measured Pitch:	-9.16
Yaw:	-73.22	Yaw:	18.12
Roll:	-5.62	Roll:	167.03
Estimated Pitch:	-20.15	Estimated Pitch:	-9.16
Yaw:	-73.18	Yaw:	18.10

Promotoren / Copromotoren: Prof. Dr. Nele Mentens
Dr. Ludo Cuypers