

Thesis and Internship Opportunities

for students in

Computer/Electrical Engineering, Microsystems Engineering, Computer Science or similar fields

Activity Classification Using Inertial Sensors and Hidden Markov Models

The Institut für Mikro- und Informationstechnik of the Hahn-Schickard-Gesellschaft develops miniaturized sensors and actuators. In the field of inertial sensors and systems. The research activities in Villingen-Schwenningen started in 1997. Since then several silicon-based micromachined sensors have been built that can either measure acceleration (accelerometers) or rotation velocity (gyroscopes). Silicon based micromachining makes it possible to produce low-cost and small size sensors for a variety of applications, e.g. navigation and stabilization systems for automotive industry or hardware for low-cost virtual-reality systems.

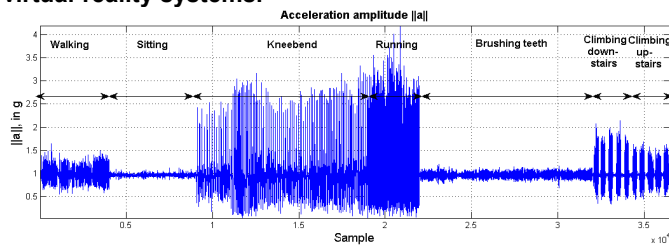


Fig. 1 Example of acceleration amplitude measured for several typical human motions.

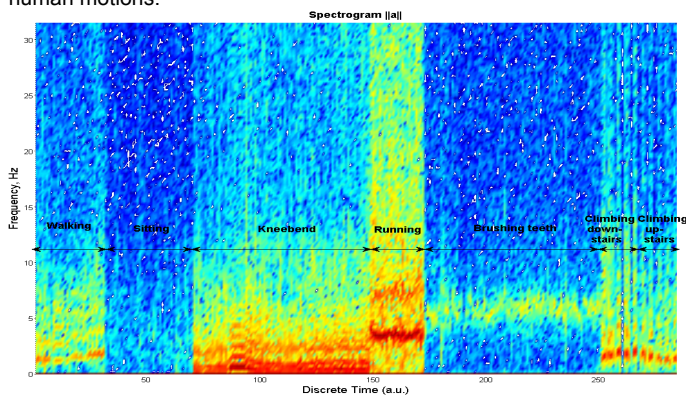


Fig. 2 Example of spectrogram of acceleration amplitude calculated for several basic human motions.

Understanding of basic human motion patterns as well as ability to recognize certain type of motions automatically is a promising research area for ambient assisted living and biomedical applications as well as location aware services. Some algorithms using standard signal characteristics can be implemented for recognizing the activity. However these algorithms can have poor scalability with the increased number of different motions, can be not robust enough for special decision making and can require special tuning. Moreover, most of them can't explicitly include the time information which could be crucial for applications where the decision has to be made based on a certain sequence of motions.

Currently available work includes:

Development of the activity recognition algorithms using inertial sensors and Hidden Markov Models (HMM). In this case the sensor signal is assumed to be an observation of the hidden system states which correspond to some typical motion patterns and state transition probabilities encode the information regarding the switching between the states.

Tasks for the student:

- Develop the classification algorithm based on HMMs.
- Evaluate the designed algorithm with respect to different features, structure of HMM and computational complexity.
- Evaluate the performance of the algorithm based on real data and robustness with respect to sensor noise.

Requirements:

- Solid background in mathematics and signal processing (familiarity with basic Machine Learning and Pattern Recognition algorithm is strongly advised).
- Very good knowledge of Matlab.

The students can make advantage of HSG-IMIT experience in developing sensor electronics and fusion algorithm. Additionally, the content of the thesis or internship thesis can be adapted to the specific interests of the applicant. We would be very pleased to welcome You as a new student co-worker of HSG-IMIT. Further information and details can be obtained from the contact listed below.

Facts about HSG-IMIT:

- Located since 1990 in the new facilities in Villingen-Schwenningen
- Currently more than 90 employees in research and development
- Typically 10-20 student co-workers per semester
- Approximately 700 m² of laboratory space with state-of-the-art equipment
- Approximately 600 m² of cleanroom classes 10-1000, solely dedicated for the production of microstructures

Benefits for our students:

- Involvement in an up-to-date and application-oriented field of research
- State-of-the-art software and equipment
- A highly motivated and interdisciplinary work environment
- A competitive compensation to which a rent subsidy can be granted
- Support in finding an appropriate room during the stay at HSG-IMIT

Your contact:



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Inertial Sensors and Systems

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