Walking analysis is a classical tool for the assessment of frailty of elderly people. However this assessment is performed only infrequently while the trajectory of life of elderly people may lead to a fast evolution. Furthermore, the duration of this assessment in a medical environment is usually very low, thereby not allowing to detect rare abnormalities in the walking pattern that may be the premises of an emerging pathology. In addition we have to address the fall problem (every year 10 000 elderly deaths are a direct consequence of a fall that has not been detected in an appropriate time): here we have both to avoid situations that may lead to a fall and to raise an alert if a fall situation has been detected. We have already successfully addressed these issues when the subject was using a wheeled walking aid so that we are now interested in the use of a cane. The use of a cane as a navigation help or for gait analysis has already been addressed to some extent in various works (see for example [1],2]) but the fall problem has never been addressed.

The objectives of this thesis are:

- to improve the gait analysis by fusing sensor data such as acceleration, angular velocity, support force,... for providing a limited set of gait indicators that may be followed over a long time period to indicate trends, while allowing for the detection of short-times abnormalities in the gait pattern

- to extend the use of this cane to rehabilitation exercises. This will require to be able to determine other indicators in a flexible way in order to take into account the specific pathology of the subject
-to take measurement uncertainties into account for a guaranteed calculation of these indicators as intervals while human variability will be accounted by using a statistical analysis

-to design an instrumentation that will allow for fall detection and for detecting postural configuration of the user that increase the risk of fall

-to instrument the cane with various subsystems that may decrease the risk of fall (e.g. self-leveraging cane for avoiding situation where the user has to lean, self-illumination for toilet trips at night,...)


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English version: