ANG, a family of multi-mode, low cost walking aid

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Motivation

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  - in France direct consequence of a fall: 9300 deaths per year

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- walking pattern is a good indication of the general state of health
  - but doctors lack of tools to objectively assess the quality of walking pattern
  - they are missing rare events that indicate emerging pathologies

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- other tasks . . .

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Solution

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Starting point: available `Rollator`, first step when motricity starts to fail

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Starting point: available `Rollator`, first step when motricity starts to fail

- already accepted devices
- close to wheelchair $\Rightarrow$ functionalities may be transferred
- low cost hardware

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Added:

- 3D accelerometer+gyro
- GPS
- rear wheels encoders
- fit-PC+ IR interface

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Objectives:

- fall detection: based on abnormal velocity/acceleration
- walking analysis: walking aid trajectory reconstructed from accelerometer and encoders measurements

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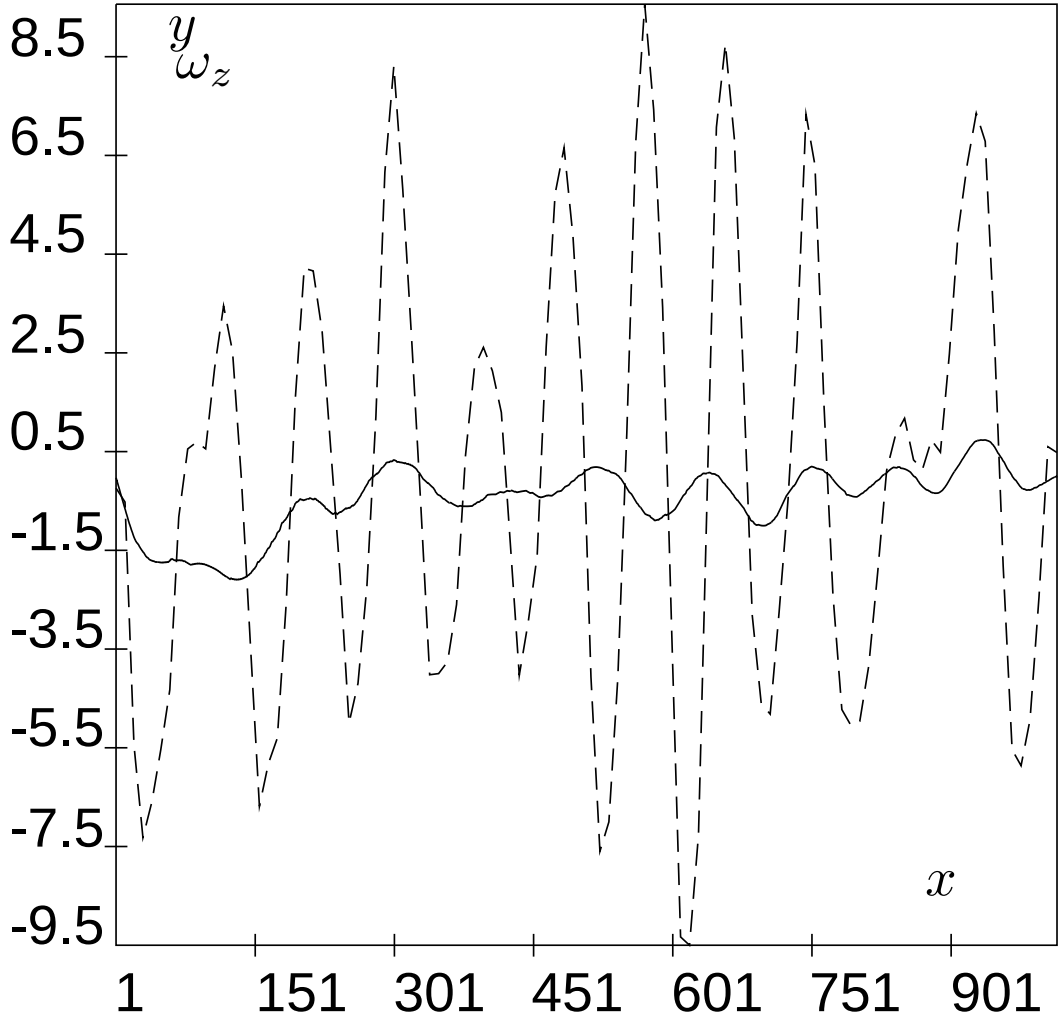
Typical records for a straight line trajectory



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Objectives

- provide a gold standard for "normal" walking patterns
  - with/without walking aid
- measure walking pattern on elderly people
  - with the walking aid
  - infer walking pattern without the walking aid
- determine indexes that are pertinent for doctors to qualify walking patterns
- detect abnormal events and report them to doctors

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Methodology

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In direct collaboration with the CHU hospital at Nice

- first phase, 2011: trial at INRIA on 24 subjects (age: between 20 and 50 years)

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  - instrumented: accelerometer/gyro on the knees and wrists, force sensors in the shoes, video recorded
  - records on trajectories with/without the walking aid performed twice, random order

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Methodology

In direct collaboration with the CHU hospital at Nice

- first phase, 2011: trial at INRIA on 24 subjects (age: between 20 and 50 years)
  - instrumented: accelerometer/gyro on the knees and wrists, force sensors in the shoes, video recorded
  - records on trajectories with/without the walking aid performed twice, random order
- second phase, currently: trials on 30 elderly people at CHU Nice
  - not instrumented
  - same trajectories performed twice with the walker

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../../../Texte/AEN/Experience-09-2011/Videos/walk.mpgVideo

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Objectives:

- fall detection: based on abnormal velocity/acceleration
- walking analysis: walking aid trajectory reconstructed from accelerometer and encoders measurements
- navigation aid

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Navigation aid

walking aid may

- measure the slope of a sidewalk
- detect a lowered kerb

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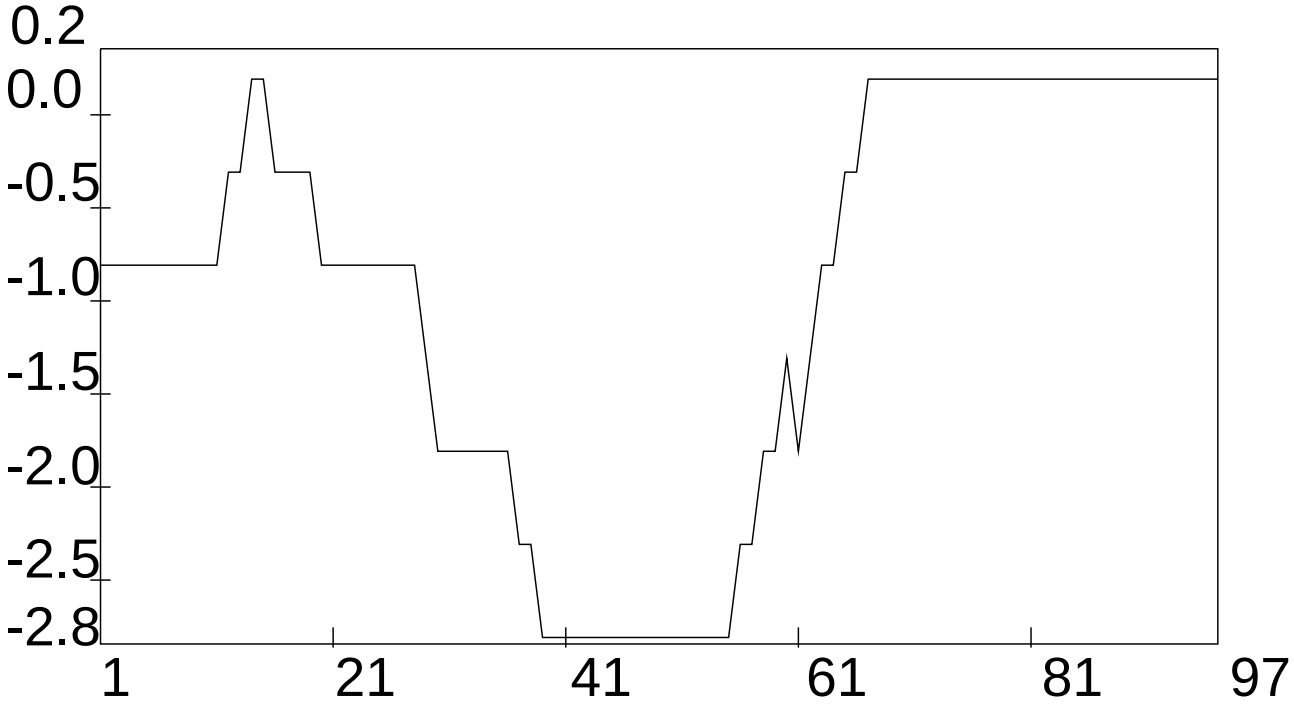
detecting/ranking lowered kerb



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Navigation aid

walking aid may

- measure the slope of a sidewalk
- detect a lowered kerb
- qualify the quality of the sidewalk surface when using a walking aid or wheelchair

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An innocuous-looking sidewalk

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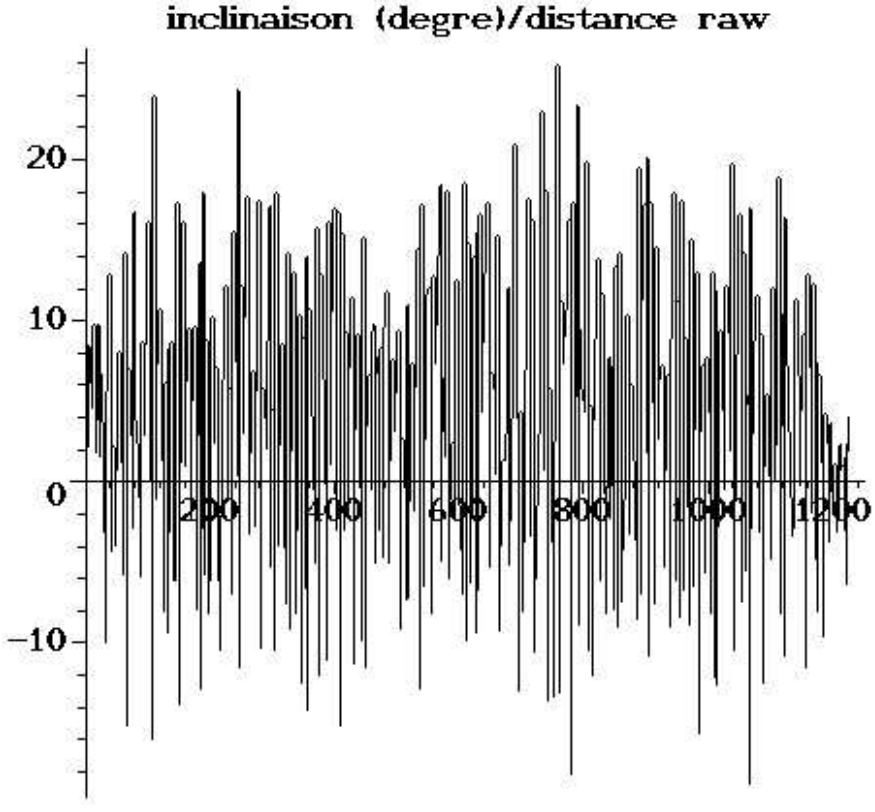
An innocuous-looking sidewalk . . . and how it feels with a walking aid



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In summary daily users of the walking aid in a city may provide very interesting information for itinerary planning in this city

How can they share this knowledge ?

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How can they share this knowledge ?

↓

information may be used to update a collaborative map (OpenstreetMap)

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To validate this concept we have:

- retrieved the map of INRIA at Sophia-Antipolis from OpenStreetMap
- used the walking aid all over our site
- then updated the map with the provided information

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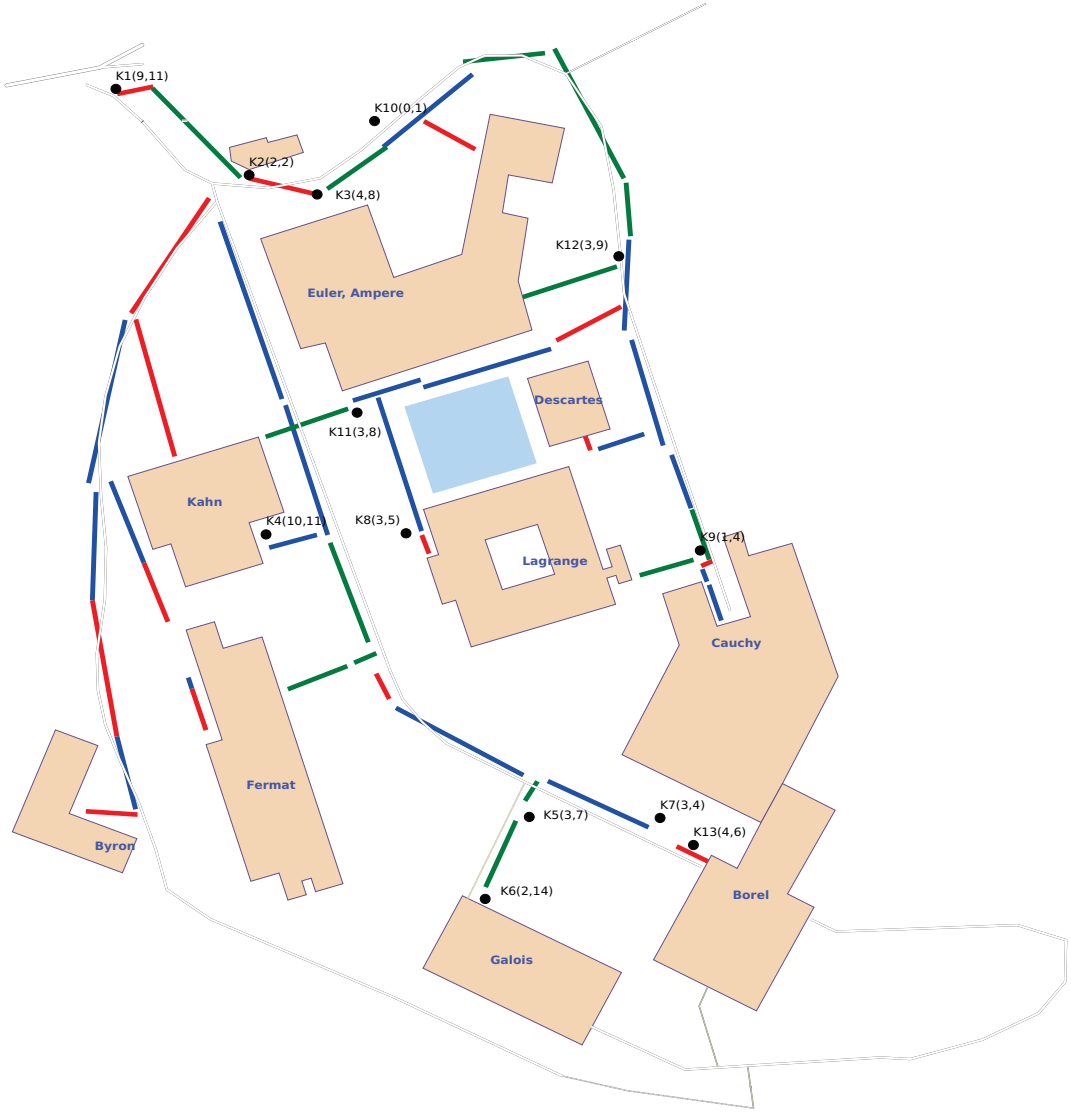

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Starting point: available `Rollator`

Added:

- 157W motors
  - electromagnetic clutch

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sensors

- 8 multidirectionnal IR distance sensors
- force sensors in the handles
- 3D accelerometers, GPS
- light sensors, 2 webcams
- GPS

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- on board vacuum cleaner
- pick-up reacher
- solar panel
- interface: IR, web, radio,joystick,handle, hand motion

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/user/merlet/home/Robot/Deambulateur/Videos/RII.mpg

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Conclusion

Already accepted walking aid may help to provide:

- on-demand mobility assistance
- fall detection/prevention, alarm
- walking diagnosis tool for doctors
- dynamic map building for itinerary planning
- navigation aid (but is that necessary ?)
- help for transfer (sit-to-stand)
- help for domestic tasks
- . . .

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