Sensor Orientation

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Fall semester

Section SSIE, Faculty ENAC
Section SYSCOM, Faculty I&C
Section SEL, Faculty STI

Fr 12:15-17:00 GR-**A331** / GR-**C02 (**or **GCD0383)**

Agenda – details per session

Navigation / Lecture	Estimation/LAB
1. Concepts & applications, LS	L1a: Random noise + ran. walk
2. Sequential LS, Random proc.	b: GM1, Auto-Correlations
3. Ref.sys1, Sensors (1*)	L2a: collect real IMU data
4. T1, Ref. sys 2	b: analyze data, AC, PSD
5. RevT1, Eq. i-frame, Sensors (2*)	L3 : dR/dt
6. Attitude sol., e-frame, Sensors (3*)	L4 : 2D INS – ideal
7. Alignment, Sensors (4*)	L5 : 2D INS – realistic case
8. T2, Align errors + Schuler	L6a: INS physic - collect
9. RevT2, KF-intuitive, Sensors (5*)	b: INS physic - evaluate
10. $\Phi=e^{F\Delta t}$, F = circ. motion	L7 : KF of GPS – model a=0
11. EKF, GPS/INS integration	L8 : KF of GPS – model a=con.
12. Filter for 2D GPS/INS integration	L9 : KF of GPS – model rdot=0
13. Direct sensor orientation, demo	L10: GPS/INS
14. T3	

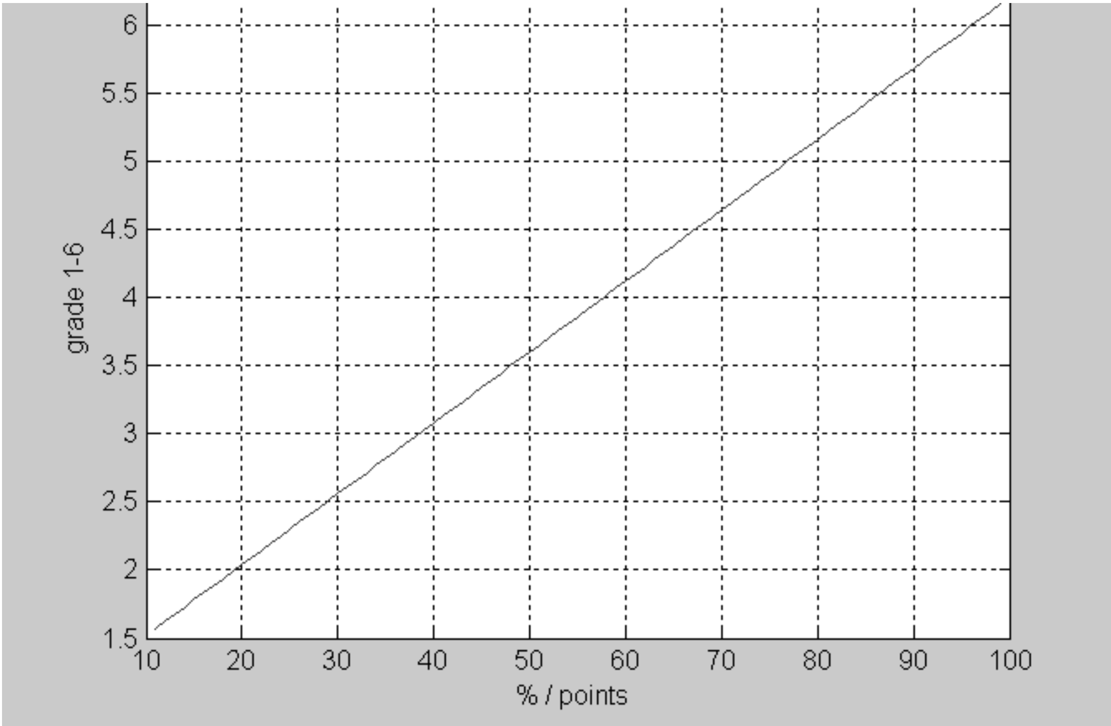
* = presented by students, practical labs

Control

□ Test 1 (lecture 4, 10.10.)	20%	
□ Test 2 (lecture 8, 07.11.)	20%	
□ Test 3 (lecture 14, 19.12.)	20%	60%
□ Participation/presentation	10%	
□ Labs	30%	40%
□ TOTAL	100%	

% → grade conversion

- Mark ~= [%] * 5.2/100 + 1



Labs – rules

- Lab weight 3-4 % per lab, 9 labs in total

- Evaluation
  - Completeness ~ 1%
  - Correctness (plots) ~ 1%
  - Answers (questions) ~ 1%
  - Penalty -0.5% per day past deadline

- Content
  - Written ~1 page: **answers** with analysis (poss. synthesis)
  - Plots (relevant)
  - Code (all)

- Hand in
  - Printed version, bring it to the course or give to the assistant

Assistant support

- Merhan Khaghani
  - main assistant from 03.10. (labs & consulting)
- Philipp Clausen
  - present in labs (and main assistant backup)
- Martin Rehak
  - present in labs

Inertial sensors – student distribution

- Gyroscopes
  - Rigid rotors gyros (RRG)
  - Nuclear resonant (NMRG)
  - Ring laser gyro (RLG)
  - Fibro optic gyro (FOG)
  - Hemispherical resonator (HRG)
  - MEMS:
    - Vibrating fork-quartz (QRS)
    - Resonant ring
- Accelerometers
  - Force/mass rebalance
  - MEMS: vibrating (QRS)
- Magnetometers

- Students
  - 1:
  - 2:
  - 3:
  - 4:
  - 5:
  - /
    - 6:
    - 7:
- /
  - 9:
  - 10:
  - 11:

First group in 2 weeks (3rd session)

Sensor presentation

- Prepare
  - 1. Presentation (~10-12 min)
  - 2. Document to be handed to colleagues (16) + PDF (slides or extended abstract with references)

- Content
  - Clear **physical concept**
  - Mathematical relations
  - **Limits** – physical and in realization/fabrication
  - **Advantages** and disadvantages (environment, size, cost, **accuracy ranges**)

Lecture summary

- Each student presents (at least ones) brief summary of the previous lecture

- Summary:
  - Slides 1-2 max
  - Or on blackboard (prepare before lecture starts)
  - 3-4 minutes max