AGENDA of Sensor Orientation

Jan Skaloud
ENAC

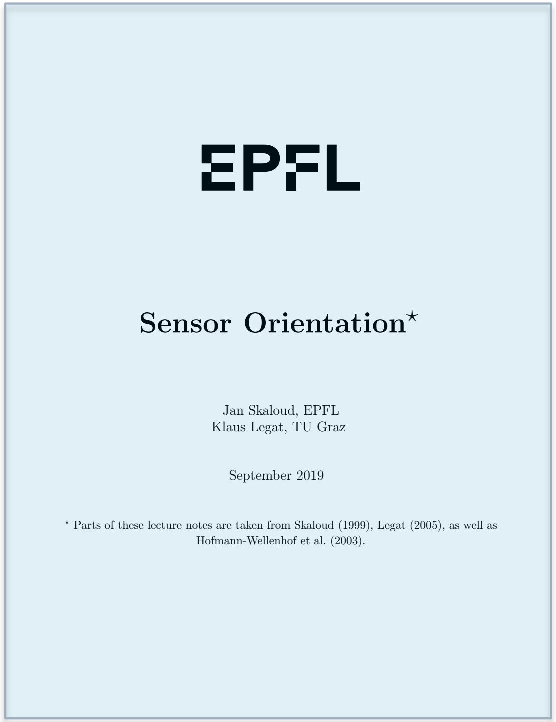
Spring semester

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

Fr 13:15-17:00 **GC D0 386 (**or/& **GC D0 383)**

Support

- Lecture notes, no.279 – RC shop


EPFL

Sensor Orientation*

Jan Skaloud, EPFL
Klaus Legat, TU Graz

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* Parts of these lecture notes are taken from Skaloud (1999), Legat (2005), as well as Hofmann-Wellenhof et al. (2003).

- moodle.epfl.ch (ENV-548)
  - **planning**
  - skeleton
  - selected **slides**
  - **lab-assignments**
  - grades

- (your notes are important !)

Agenda – details per session

Orientation / Lecture	Estimation/LAB
1. Intro, LS review, Random proc. 1	L1a: noise gener.:WN, RW, GM1
2. Seq. LS, Random proc. 2	b: noise characteristics
3. Ref. systems 1+2, Sensors (1*)	L2a: collect real IMU data
4. T1, R, dR, Eq. i-frame	b: analyze & characterize
5. PL: e-frame, Attitude Sol., Sens.(2*)	L3 : dR/dt
6. l-frame, num. integ., Sensors(3*)	L4/5 : 2D INS – ideal + realistic
7. Alignment principle, Sensors(3*)	L5 : 2D INS – realistic case
8. T2 Alignment limits, Schuler	L6: INS physic – initialization
9. KF-intuitive, Sensors (4*)	L7 : KF of GPS – model a=0
10. $\Phi = e^{F\Delta t}$, obs., Sensors (5*)	L8 : KF of GPS – model a=con.
11. EKF, INS/GNSS integration	L9 : KF of GPS – model rdot=0
12. Total x vs. Δx, GPS/INS in 2D	L10a: GPS/INS – implement
13. T3 Direct sensor orientation	b: debug

* = presented by students, practical labs

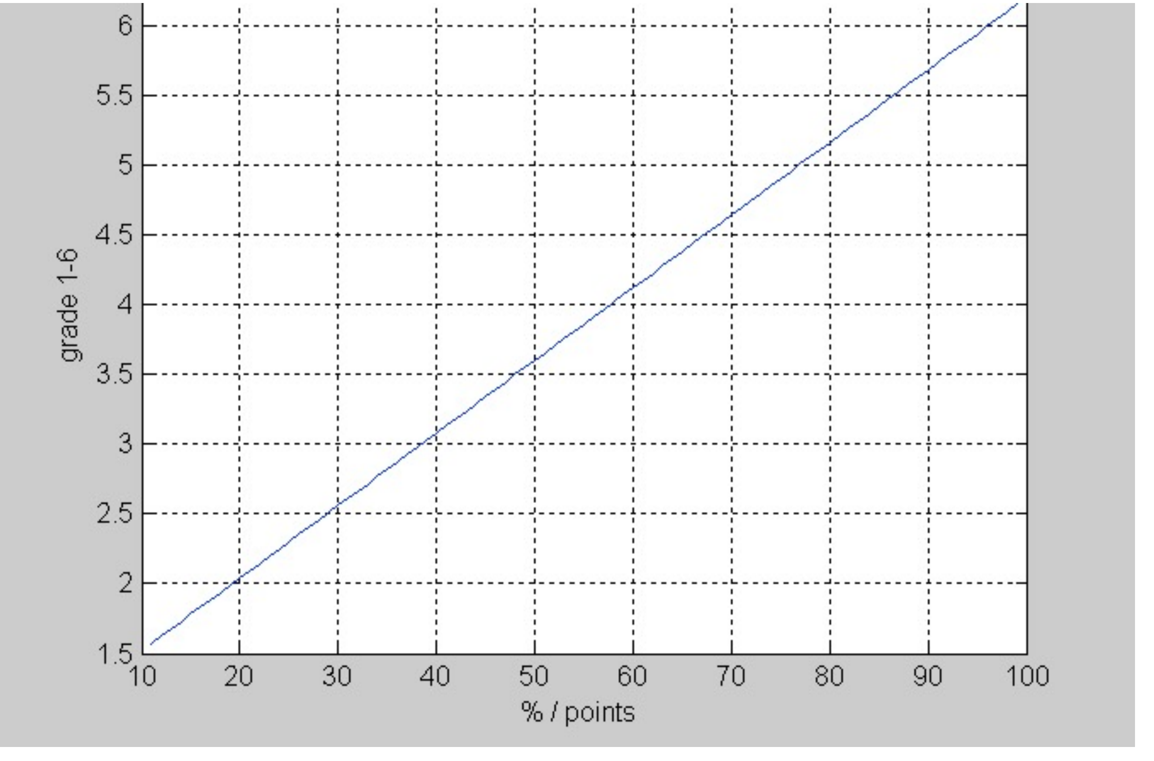
——— = Eastern break

Control

Test 1 (lecture 4, 17.03.)	20%	
Test 2 (lecture 8, 28.04.)	20%	
Test 3 (lecture 13, 02.06.)	20%	60%
Participation/presentation	10%	
Labs	30%	40%
TOTAL	100%	

% → grade conversion

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



Labs – rules

- Lab weight 3% per lab, 10 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 that is new)

- Hand in
  - via Moodle, deadlines – Friday 11AM

Lab - evaluation

- **C**ompleteness – 1/3
- **C**orrectness – 1/3
- **A**nswers – 1/3

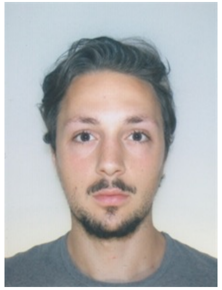
- Later delivery – 50% (of the lab weight)

- Reports:
  - Answers – max 1 page
  - Description (plots) – n pages
  - Code (with all functions)

Assistant support

- Aman Sharma
  - main assistant (labs & consulting)

- Pasquale Longobardi
  - present in labs (& consulting)



- Kenneth Joseph Paul
  - present in labs (& consulting back-up)

Sensor presentation (group of 2)

- Prepare
  - 1. Presentation (~7-8 min)
  - 2. PDF version sent to teacher (slides or extended abstract with references)

- Content
  1. **Physical concept** , mathematical relations
  2. **Limits** – physical and in realization/fabrication
  3. **Advantages** and disadvantages (environment, size, ~cost, **accuracy ranges**)

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)
  - MEMS: Resonant ring
- Accelerometers
  - Force/mass rebalance
  - MEMS: vibrating (QRS)
  - Compact cold-atomic
  - MEMS gravimeter
- Magnetometers

- Students
  - 1:
  - 2:
  - 3:
  - 4:
  - 5:
  - 6:
  - 7:
  - 8:
  - 9:
  - 10:
  - 11:
  - 12:

First group in 2 weeks (3rd session)