



Advanced Instrumentation

(Autumn 2025)

Instructor: [H. Golpira](#)

Course Description and Objectives

It equips students with the fundamentals of measurement and instrumentation systems. Covers three primary aspects of sensing, signal processing, and data acquisition. Furthermore, data analysis and test procedure is covered through the lab course and homework. It is a fundamental course for biosystems and agricultural engineers who work on precision farming, digitalization in agriculture, or smart farming technologies.

Topics Covered

Part I: Instructor: H. Golpira

1. AM & FM
2. Microwave Doppler velocity sensor
3. FMCW distance sensor
4. LVDT
5. Resistive Wheatstone bridge for strain measurement
6. Noise
7. Filters
8. FFT
9. Errors
10. Drone-based and satellite sensing
11. SNR and PSNR
12. MEMS

Part II: Instructor: Technicians in the Department of Biosystems Engineering

1. Lab course: Students apply a sensor to an autonomous system virtually or mechanically. Ultrasonic, LiDAR, Gas CEMOS, and SQUID sensors are common types. This will give students a chance to deepen their knowledge in a specific area.



Homework/Assignments

The course assignments will be performed throughout the semester.

1. Homework 1: A signal should be processed using FFT in MATLAB. You will provide a detailed written report and simulation files.
2. Homework 2: The application of PSNR in an automatic fruit sorter

References

- [1] Webster, J. G., & Eren, H. (2018). [Measurement, Instrumentation, and Sensors Handbook](#): Two-Volume Set. CRC press.
- [2] Golpira, H., & Golpîra, H. (2013). Application of signal processing technique for the modification of a fruit sorting machine. *International Journal of Advanced Mechatronic Systems*, 5(2), 122-128.
- [3] Golpira, H., & Golpîra, H. (2012, September). Improvement of an apple sorting machine using PSNR criterion. In *The 2012 International Conference on Advanced Mechatronic Systems* (pp. 729-732). IEEE.
- [4] Golpira, H., & Golpîra, H. (2017). Redesign and evaluation of an automatic fruit sorter. *The International Journal of Advanced Manufacturing Technology*, 89(5), 1791-1798.

Grading

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| • Homework: | 25% |
| • Final Exam: | 50% |
| • Lab course: | 25% |