Erasmus Mundus Joint Master Degree in Image Processing and Computer Vision (EMJMD-IPCV)

Applied Video Sequence Analysis

Lab 3 “Kalman filtering for object tracking”

Collaborative work (part II)

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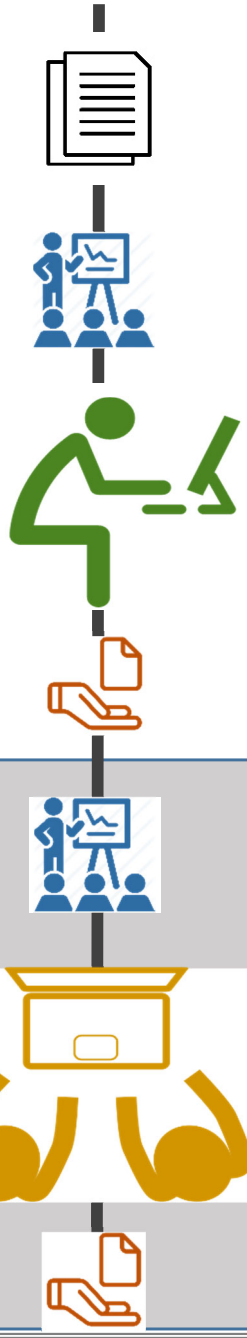
TIMELINE



04/04/22 Materials available in Moodle

05/04/22 Presentation of programming assignment LAB3
Description of individual work

05/04/22 - 19/04/22 Individual work (easter holidays 11/04/22 - 18/04/22)

19/04/22 Submission of individual work

19/04/22 Description of collaborative work available
Moderated Q&A session for individual work
(individual session, requested by teacher if needed)

19/04/22 - 05/05/22 Collaborative work

05/05/22 Submission of collaborative work

EVALUATION

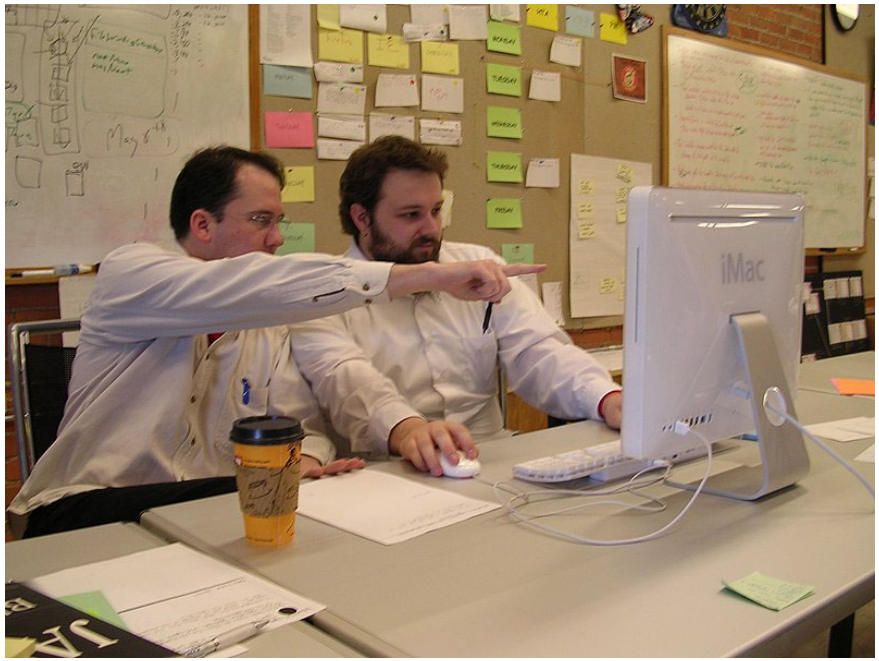
- This lab assignment will be **graded with 10 points**

Type	Concept evaluated	TASK	Max. Score	Criteria evaluated
Individual (35%)	Source Code	Task 3.1	2.5	Code: Functional requirements (60%) Code: Design & structure & Style (40%)
	Report	Task 3.1	1	Report: Introduction & methods (40%) Report: Analysis & discussion (60%)
Collaborative (65%)	**Source Code**	**Task 3.2**	**1**	**Code: Functional requirements (60%)** **Code: Design & structure & Style (40%)**
	Report	**Task 3.3**	**2.5**	**Report: Experimental methodology (40%)** **Report: Analysis & discussion (60%)**
		Task 3.4	**2.5**	**Report: Experimental methodology (40%)** **Report: Analysis & discussion (60%)**
		Task 3.5	**0.5**	**Report: Analysis & discussion of team dynamics. Teamwork log. (100%)**
		TOTAL	**10**	

- Delivery not following requirements: -0.5 points
  (e.g., submission without makefile or without three directories; report not using the course format)
- Late delivery after the remaining days of the late policy (remember 4-days in total)
  - -25% (one day), -50% (two days), -75% (three days), -100%(>= four days)

COLLABORATION?

- Methodology based on pair programming[1]
  - Two programmers/students do a combined effort to develop software using the same computer (either remotely or physically in the same place)
  - Roles:
    - *Driver:* develops and writes code, controls the inputs (mouse, keyboard)
    - *Navigator:* checks written code, suggests alternatives, looks for errors, asks for clarifications,…
    - Roles are exchanged periodically



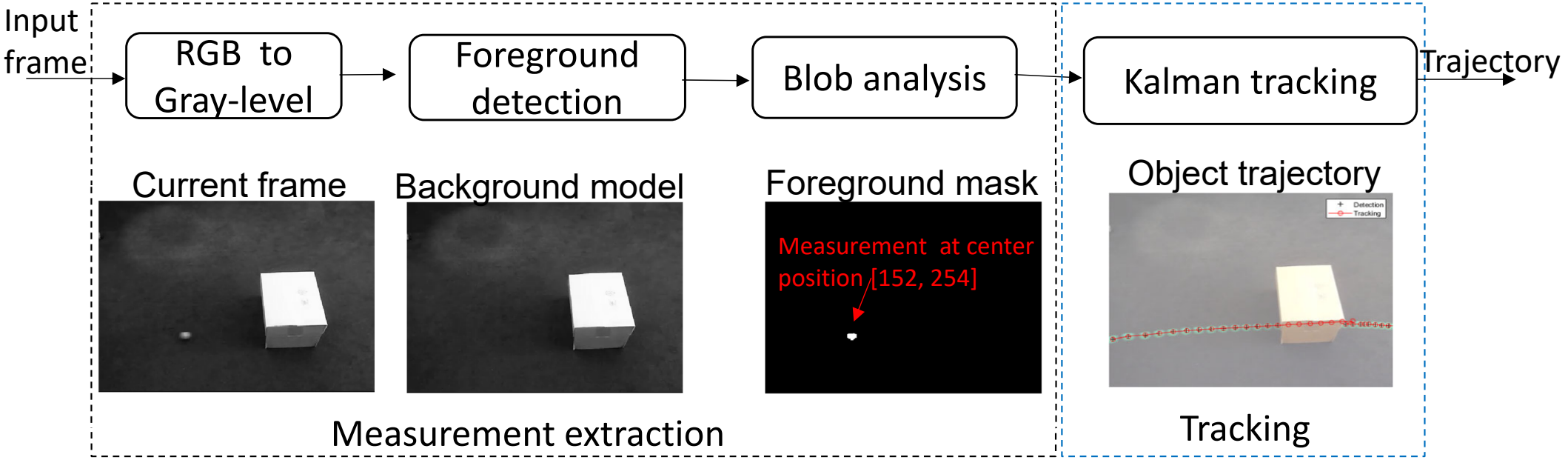
Source: Wikimedia.commons.org

  - Methodology frequently applied in the software and tech industry and (to a lesser extent) for university teaching in programming courses
  - Further documentation and guidelines are provided in Moodle

[1]Bevan, J. et al. “Guidelines for the use of pair programming in a freshman programming class”. In IEEE CSEE&T, 2000.

3.1 Based on Background Subtraction: code implementation

Objective: implement a single-object tracker based on background subtraction and Kalman filtering like the one described in lectures



TASK ALREADY COMPLETED WITH INDIVIDUAL WORK,
BUT YOU MUST MERGE INDIVIDUAL CODES OF TASK 3.1a & TASK 3.1b

3.1 Based on Background Subtraction: code implementation

3.2 Based on Background Subtraction: analysis of toy data

Objective: based on task 3.1, analyze the effect of Kalman components for toy video sequences while keeping fixed measurement extraction

Task: change the parameters of the Kalman Filter (KF) for each sequence. You **must keep fixed the values of the MOG-based Extraction of the Object Measurement (EOM) for all test video sequences**. You may change EOM params, but a justification is needed in the report.
(suggested MOG parameters: learning_rate=0.001, varThreshold=16 and history=50; parameters for Opening: size=3x3, type=MORPH_RECT; parameters for blob extraction: min width=50, min height=50)

Test sequences: “video2.mp4”, “video3.mp4”, “video5.mp4” and “video6.mp4”

Submission:

- Source code with the best param settings for “video2.mp4”
- Report: experimental methodology, analysis and discussion of results, and a selection of visual examples for good/bad cases.

COLLABORATIVE TASKS

3.1 Based on Background Subtraction: code implementation

3.2 Based on Background Subtraction: analysis of toy data

Objective: based on task 3.1, analyze the effect of Kalman components for toy video sequences while keeping fixed measurement extraction

Suggestions: explore Kalman parameters starting from the result of task 3.1, explore differences in tracking performance (i.e. how good is the estimated trajectory)…

1) …between the constant velocity and acceleration models.
2) …when initial Prior Covariance (P_0 matrix) changes from the default value seen in lectures.
3) …when measurement noise covariance (R matrix) changes from the default value seen in lectures.

No performance evaluation metrics are needed to be computed , just identify visually which parameter setting performs better

COLLABORATIVE TASKS

3.1 Based on Background Subtraction: code implementation

3.2 Based on Background Subtraction: analysis of toy data

3.3 Based on Background Subtraction: analysis of real data

Objective: analyze and tune the tracker implemented in task 3.1 for real video sequences from changedetection.net

Task: for each sequence, you can change the parameters for the MOG-based Extraction of the Object Measurement (EOM) and the Kalman Filter (KF). The task here is to adjust SOME (OR ALL, IF NEEDED) parameters for each sequence.

Test sequences: "boats_6950_7900_clip.mp4","pedestrians_800_1025_clip.mp4", "abandonedBox_600_1000_clip.mp4" and "streetCornerAtNight_0_100_clip.mp4"

Submission:

- Source code with the best param settings for "abandonedBox_600_1000_clip.mp4"
- Report: experimental methodology, analysis and discussion of results, and visual examples of good/bad cases.

COLLABORATIVE TASKS

3.1 Based on Background Subtraction: code implementation

3.2 Based on Background Subtraction: analysis of toy data

3.3 Based on Background Subtraction: analysis of real data

Objective: analyze and tune the tracker implemented in task 3.1 for real video sequences from changedetection.net

Suggestions:

1) Analyze the tracking problems that exist for each sequence
2) You may keep fixed the KF params for all sequences and adjust EOM params for each sequence. Must justify any changes from default values of KF params
3) You may keep fixed the EOM params for all sequences and adjust KF params for each sequence. Must justify any changes from default values of EOM params
4) Or you can change both EOM and KF parameters simultaneously

No performance evaluation metrics are needed to be computed , just identify visually which parameter setting performs better

COLLABORATIVE TASKS

3.1 Based on Background Subtraction: code implementation

3.2 Based on Background Subtraction: analysis of toy data

3.3 Based on Background Subtraction: analysis of real data

3.4 Reflection on the collaboration and individual work

You must include in the report an appendix with the following information (it does not count towards the max page limit of the report):

1) Difficulties found during the individual work stage
2) Modifications or fixes of individual codes when combining these codes collaboratively for building the pipeline for task 3.1
3) Time log for collaborative work with time/data of each session, the student roles and main objective of the session (keep in mind that it does not need to be very detailed)
4) Overall impression of the hybrid pair programming methodology for LAB3

COLLABORATIVE WORK - WORKLOAD

- Expected workload for each student (~15 hours total):
  - ~0h face-to-face (in classroom)
  - ~15h non-presential

TASK	Expected hours	Type of work
-	0.5 (~5%)	Lecturer presentation of the lab3 – Part II
-	2 (10%)	Integration of individual work from task 3.1
Task 3.2	6 (~40%)	Running experiments, adjusting params & Description/analysis in the report
Task 3.3	6 (~40%)	Running experiments, adjusting params & Description/analysis in the report
Task 3.4	0.5 (~5%)	Collaborative log. Reflection on the individual and collaborative work.
TOTAL	15 (100%)	

COLLABORATIVE WORK- SUBMISSION

1. Assignment available on Moodle to submit your material

→ LAB3 – Collaborative work (deadline 05/05/22 10AM)

- The material must be submitted as a ZIP file with the following format *Surname1name1_Surname2name2_lab3.zip*
- The submitted ZIP file will contain
  - Report in PDF format following the template (max 6 pages, task 3.4 does not count for the limit)
  - Three directories "T31", "T32" & "T33" containing :
    - *Makefile* to compile and link the program by simply running *make*
    - "src" directory with all source files (.h, .hpp, .c and .cpp) necessary for compiling and executing the corresponding program in Linux
    - **Please do not submit configuration files of Eclipse**

Each pair must submit the work only once