Masters in Computer Vision / Vibot
Software Engineering Project
2015-2016

Laplacian coordinates for seeded image segmentation [1]: an implementation

1 – Introduction

The goals of this project include:

1. To **develop your C++ programming and Software Engineering skills** through the implementation of (part of) a research paper on seeded image segmentation.
2. To **build bridges with some of the other courses**, mostly Applied Mathematics and Image Processing
3. To introduce you to the **understanding of research paper** as well as the evaluation of a research semester since the evaluation criteria are very close
4. To **sharpen communications** skills through presentations and reports.

The main task of the project can be phrased as follows:

Given a color image and some manually annotated pixels, provide a segmentation of the image in 2 regions using the algorithm proposed in [1] as illustrated below (image taken from [1]):

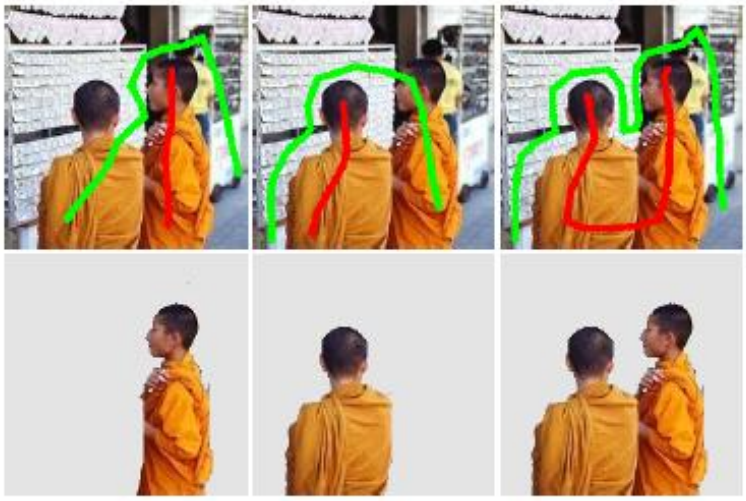

Figure 8. Selecting different objects from the image by exploiting the seed sensitivity of the Laplacian Coordinates. First row: multiple selections are given as input to the method. Bottom row: the corresponding segmentations.

Figure 1: Typical result for seeded segmentation in 2 regions. Image and text taken from [1]

At first sight, this might seem a very ambitious project, since CVPR is one of (if not the most) prestigious conference in computer vision… However, when you read carefully, the paper is so well written that it is eventually not so complicated to come up with an implementation. Besides, it uses most of the tools you are going to learn this semester.

Please notice that **you do not have to implement the whole paper** (!). Naturally, any additional improvement will be appreciated and will be rewarded with bonus points. For instance, if you are able to quickly obtain preliminary segmentation in 2 regions, you can use some of the extensions provided in the paper to segment the image in multiple regions, as illustrated below:

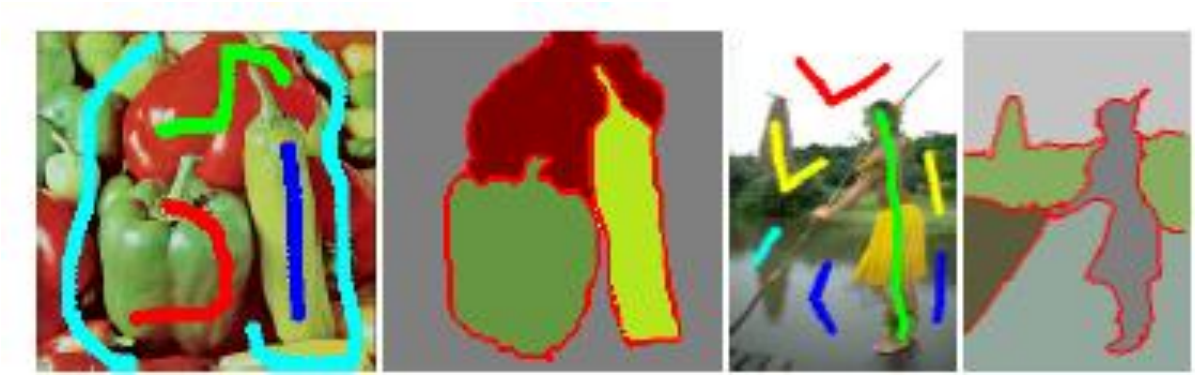

Figure 2: Segmentation examples with multiple regions [1]

2 – Project requirement s, constraints, and specifications

Please, pay attention and respect the following instructions:

1. Deadlines
    a. All the deliverables (report, code, presentations…), must be submitted (or downloadable) **no later than January the10th 2016**
    b. The defense (final presentation) will be held during the **second week of January** (from the 11th to the 15th)
    c. **Intermediate presentations** will be held in mid November (precise date will be adjusted depending on your workload and progresses)

2. Project Management
    a. The students can work alone **up to three students per group**
    b. Each student group has to submit a **progress report every month**. This document does not need to be unnecessary lengthy : it just aims at letting the teaching staff to know if you progress smoothly or if you need help
    c. Please **use collaborative tools** for more convenient PM, such as Trello (https://trello.com/) and Git Hub (https://github.com/)

3. Constrains
    a. You are not allowed to use Matlab at all
    b. Code must be 100% C++ and compilable under Linux, Mac-OS, **and** Windows
    c. Your project must be a Qt project. Please document on how to install libraries if needed

d. You must handle and process images using the opencv lib (http://opencv.org/)
e. For linear algebra you can use opencv functions and structures, but you might want to use specific features available in the Eigen library(http://eigen.tuxfamily.org/index.php?title=Main_Page)
f. The use of any other library must be discussed with the teaching staff
g. If you had any question, prefer Edmodo to open a discussion rather than e-mails so that all your classmates can benefit from it

3 – Deliverables and assessment

1. Deliverables
    a. **Commented** source code written in C++ under Qt, all submitted before deadlines
    b. All the reports (intermediate and final), must be in .pdf format and have been generated using LaTeX (https://www.latex-project.org/, http://www.texniccenter.org/, http://www.lyx.org/)
    c. Presentations must be in .pdf format

2. Assessment

The final result, which will be your result for this module, will be based on the following results:

a. **One technical mark, noted TM (75%)**, including the quality of your implementation, the critical evaluation of your results, the easiness of use of your software, and all the unnecessary improvements or extra ideas you might have added in your program
b. **One presentation mark, noted PM(12.5%)**, including the quality of your presentations (the intermediate ones as well as the final one) and reports
c. **One project management mark, noted PMM(12.5%)**, which corresponds to a proper management of your project (smooth analysis, no rush at the end, early discussions with the teaching staff, etc.)

The overall result will be computed as R = 0.75*TM + 0.125*(PM + PMM)

4 – References

[1] - Casaca, W., Nonato, L. G., & Taubin, G. (2014, June). Laplacian Coordinates for Seeded Image Segmentation. In *Computer Vision and Pattern Recognition (CVPR), 2014 IEEE Conference on* (pp. 384-391). IEEE. Available at http://tinyurl.com/nz77gcm

5 – Conclusion

Whatever happens, **never hesitate to ask** if you needed further information. Do not be afraid to **take some time to understand the paper**. Do not worry if you do not fully understand the paper. Try to **work in parallel**, and do not only focus on the implementation.

Most importantly, **enjoy**.