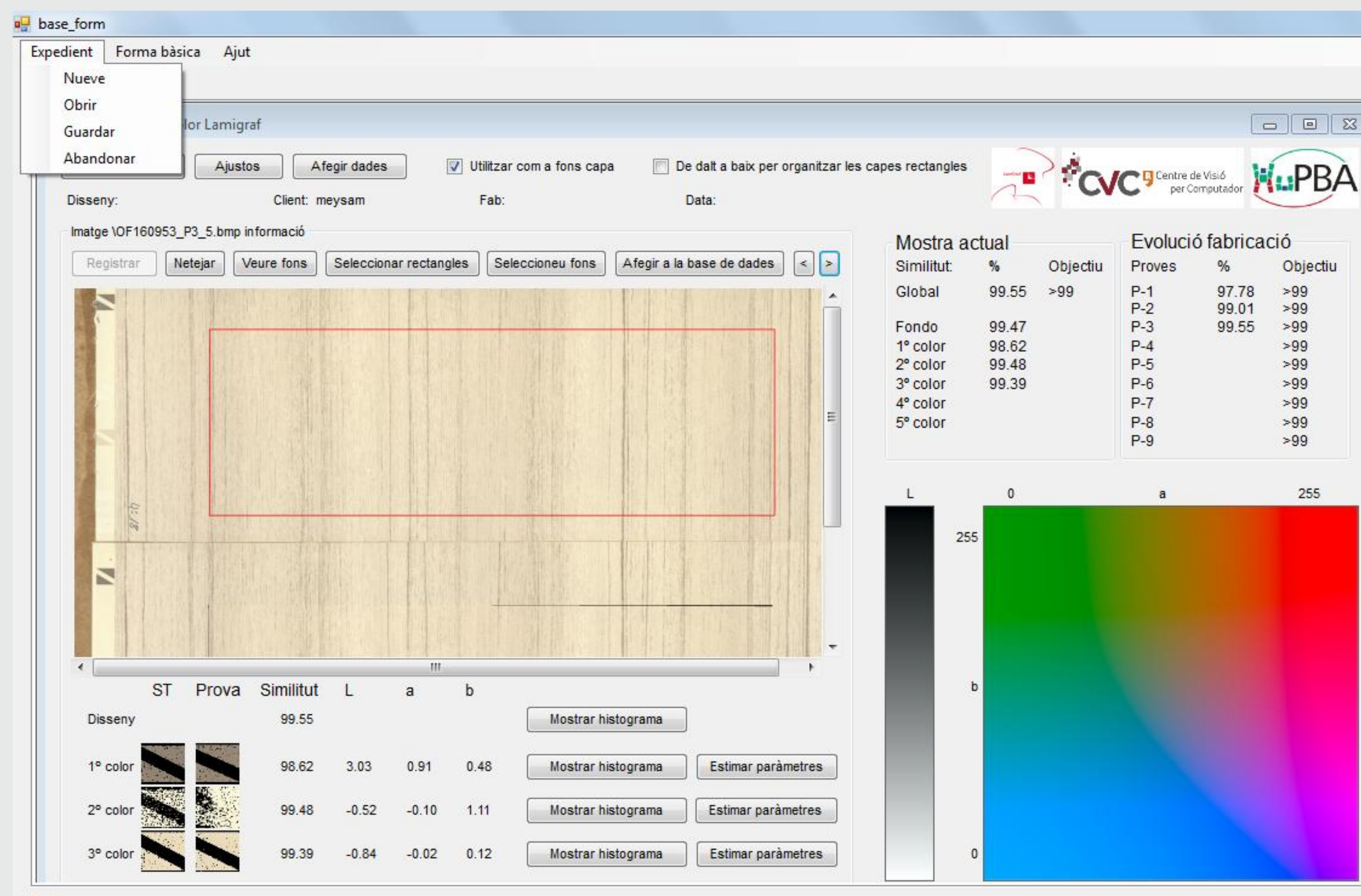




Color alignment in industrial printing: An application

Introduction

Printing industry has advanced a lot recently. However, selecting a printing method considering printing quality and cost along with uncontrolled parameters like temperature, humidity and even base paper quality, make it hard to have a desire printing mostly when you must compare to a previous printed master template. It makes it even harder when you have your own ink space and you have to reach to this specific master template. Recently I was working on an application in the domain of industrial printing which helped the users to obtain the most similar pattern to a template design in terms of color with less time and ink waste and more accuracy.



A screenshot of the application

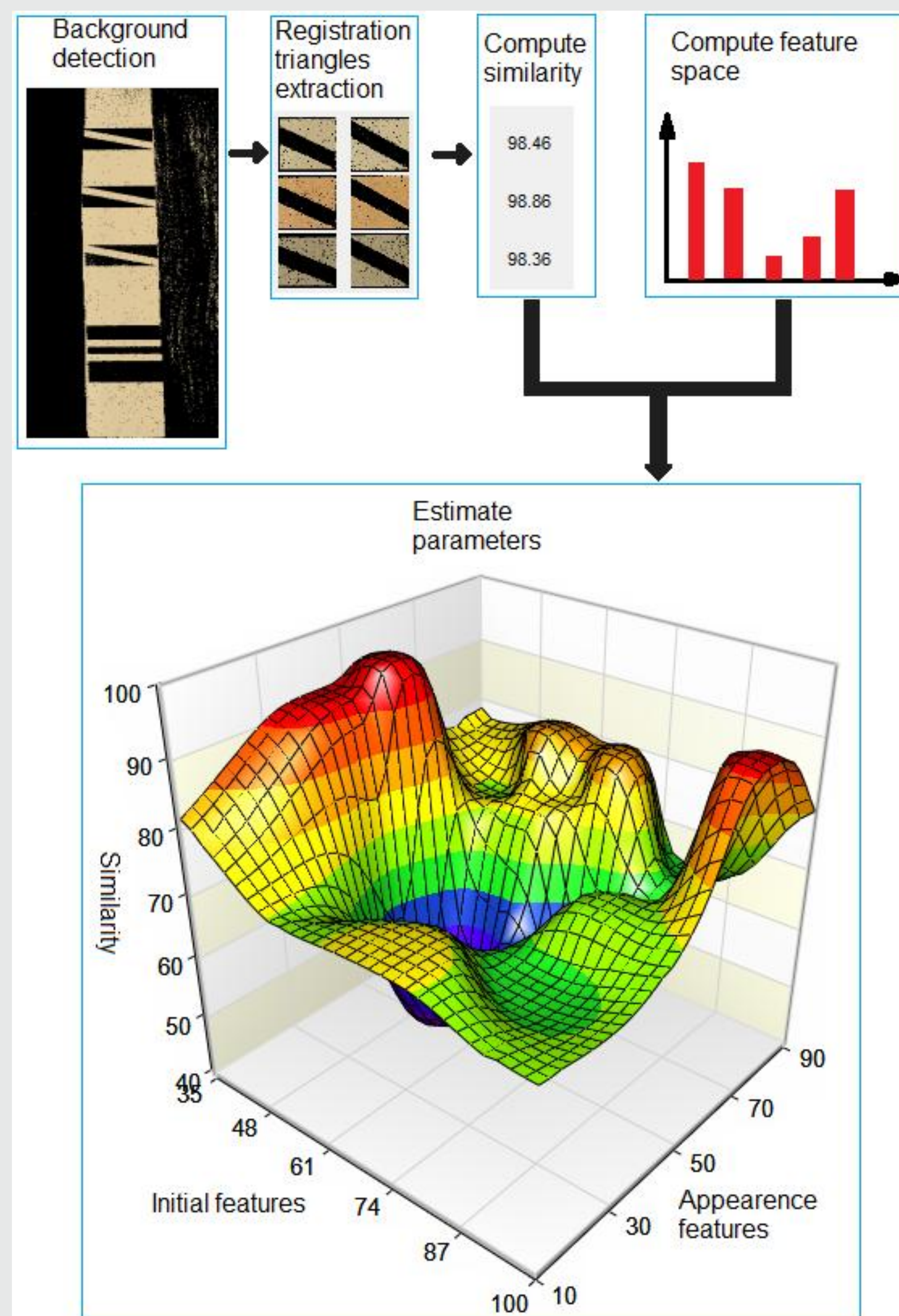
Future work and challenges

Regardless of this project, I have started my PhD since May and as the future work, we intend to concentrate on human pose recovery and computer interaction. A challenge in this part is time efficiency for real time applications especially for multi-camera systems. Working with depth data has been easier since launching new depth sensors like Kinect. Although, difficulties still remain due to the noise in or density of point clouds, objects' boundaries, etc. Model free approaches in depth data has been reported as high speed solutions to pose recovery, however, their segmentation accuracy needs more work. Gesture classification highly depends on how we model the object or the way we extract features. Some other difficulties can be mentioned as motion modeling, motion analysis and scene analysis.

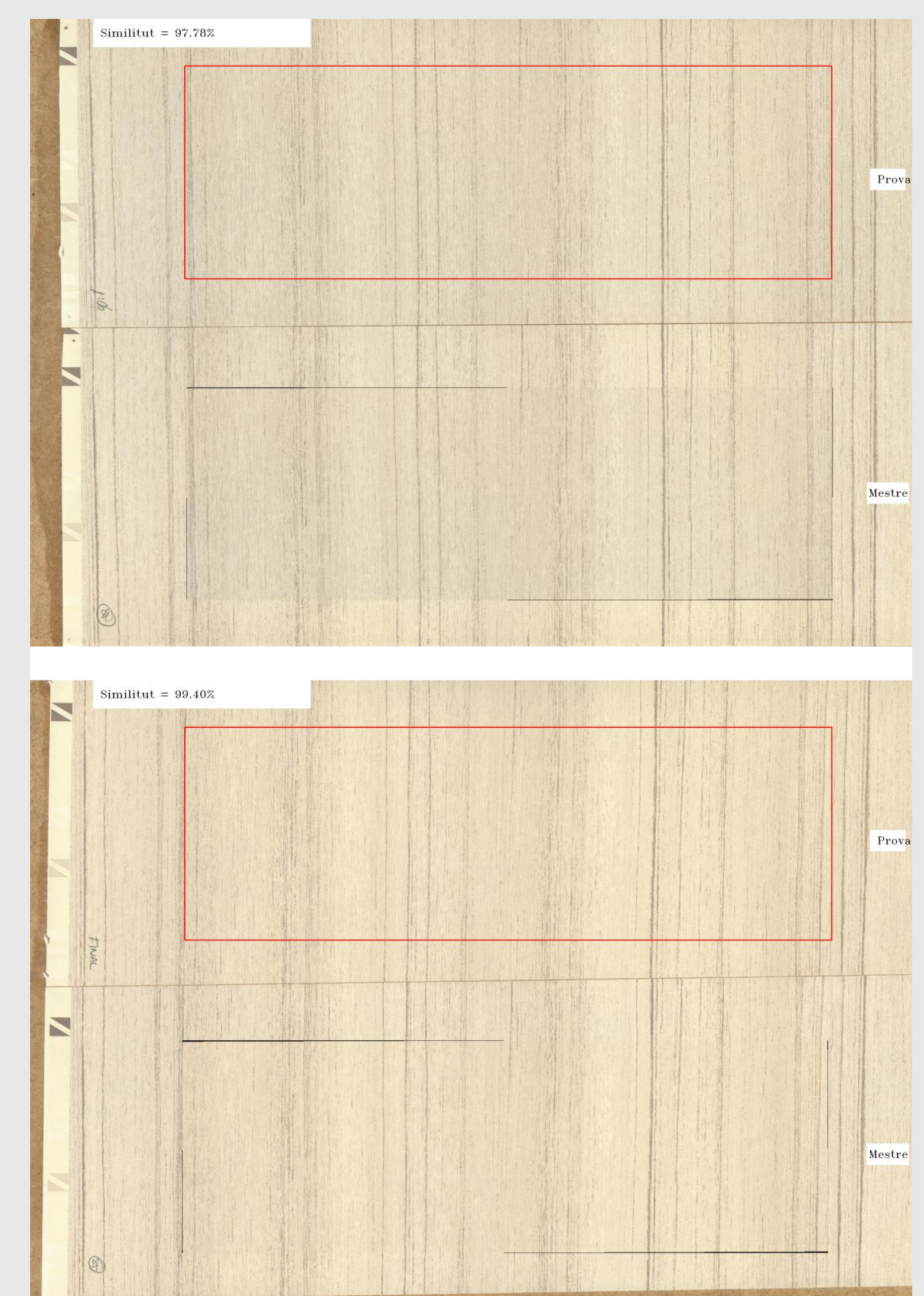
Methodology

We proposed to analyze the colors of each layer independent to other layers. Due to the limitations in the company processes, we could only work with the registration triangles. Methodologies used are as follows:

- Registration:** Applying normalized correlation coefficient.
- Background detection:** Computing SVD on sliding windows, taking areas lower than a threshold, computing histograms of colors on them, and cutting undesired areas from histograms.
- Triangle detection:** Cutting outside edges of background using vertical profile of background, clustering the colors in two fold by EM, and finding triangles through sampling background color in clusters.
- Similarity:** Converting colors to L^*a^*b space, dividing space into parts and computing the histograms in this space, and computing earth mover's distance on the feature vectors.
- Parameters estimation:** Computing Kriging interpolation on the nearest features from database to current feature vector. Feature vector is computed from :
 - ink formula +
 - machine parameters +
 - mean master foreground color +
 - mean master background color +
 - mean test foreground color +
 - mean test background color +
 - similarity.
- Histogram mean:** Fitting a Gaussian model on the color space.



Process diagram of the system.



Qualitative results. The background paper is seen on the left side as a narrow strip, and the base color of each layer is located on this background as parallel triangles. Printing machine uses these triangles to register different layers correctly. The upper side of the image is the test pattern which should become similar to the bottom master pattern as much as possible.