

Ph.D. topic 2014

Modeling of spatial and temporal organization in images and videos

Supervisor

Dr. Thomas BOUDIER (UPMC/IPAL) - thomas.boudier@upmc.fr

Co-supervisor

Dr LOO Lit-Hsin (BII/A-STAR) - loolh@bii.a-star.edu.sg

Presentation of the Ph.D. topic

Segmentation of images, i.e. detection of objects, still remain a challenge in image analysis. However most of the algorithms consider objects in the images as individual, the context is not taken into account. This context, as seen as the spatial organisation of objects, is nevertheless most important in many situations, like for instance surveillance video, robotics computer vision or biomedical data. The context can help segmentation algorithms to have more confidence in areas where objects should be according to the context definition. Some work have been done in incorporating spatial information into segmentation algorithms but in a rather *ad hoc* manner. In this project we would like to build a formalised model of spatial organization, and use it as supplementary information for the segmentation algorithms.

Expected deliverables

This project aims at building a formalised model for spatial and temporal organization in images. We are currently developing tools to create complex spatial organization patterns based on local spatial relationships. We are using the RCC8D formulation to build complex structures like fibres, glands,... In order to implement the model, we are planning to use logical programming to efficiently describe the spatial relationships and their formal implications (for instance symmetry "A outside B", then "B outside A"; transitivity "A included B", "B included in C", then "A included in C"). With this formal description we can also model composition between relationships ($R1(A, B)$, $R2(B, C)$ then $Ri(A, C)$). The interest of the RCC8D formulation is three-fold : it is quite intuitive, it is based on mathematical morphology, and it can be easily extended to other relationships.

For segmentation, or detection, of objects inside the image, a joint approach will be investigated that integrates the bottom-up low-level visual cues and the top-down high-level knowledge. In a bottom-up approach detected objects could be then analysed to describe their relationship, using classical RCC8D formulation and maybe also introducing new relation like orientation (left-right, above-below with defining canonical reference

Image & Pervasive Access Lab

1 Fusionopolis Way
#21-01 Connexis, South
Tower
Singapore 138632

Tel. (65) 6408 2542

Director. (65) 6408 2536

Fax. (65) 6776 1378

secretariat@ipal.cnrs.fr

www.ipal.cnrs.fr

either for the entire image or for a reference object), or geometric relation (surrounds, encompass, parallel along, ...). Novel higher order hierarchical conditional random field could be developed to capture the neighbouring appearance relationship of different visual cues, for instance the segmentation of different biological entities such as nucleus and nucleolus.

For top-down approach the relationship could be used to detect groups of objects satisfying specific organization. The model, based on RCC8D formalism and logic-programming, can be linked to classical morphology operators to build masks describing the relationship and describing context-based search zones. For instance if we search for people around a table, from the relation "around", the program will build a mask around the table where the people objects should be. This map can be quantitative, using a metric, in order to indicate the distance to the table. These operations rely on combination of classical morphology operators using either flat or non-flat structuring elements.

Many applications are planned in different areas with different Singaporeans collaborators in I2R, NUS and BII, like satellite imaging, videos or 2D/3D biomedical imaging.

Keywords

Image analysis, logic-based modeling, spatial organization, 3D, video.

Applicant profile

- Master Degree or Engineer Student (last year of studies).
- Skills in programming, preferably JAVA.
- Notions in image processing. Notions of modeling.
- Open to work with both French and Singaporean scientists
- Availability for starting October 2014.

Gratification: Compliant to French Regulation on Ph.D. students (Contrat doctoral)

Image & Pervasive Access Lab
1 Fusionopolis Way
#21-01 Connexis, South
Tower
Singapore 138632

Tel. (65) 6408 2542
Director. (65) 6408 2536
Fax. (65) 6776 1378

secretariat@ipal.cnrs.fr
www.ipal.cnrs.fr