

PhD thesis proposal

Title: Incremental analysis system based on multiple representations and contextual information for image analysis

Keywords: pattern recognition, system approach, collaboration of classifiers, incremental analysis, contextual information, image processing

Organism: Computer Science Laboratory (LI EA 2101), François Rabelais University, 64 avenue Jean Portalis, 37200 Tours, France (<http://www.li.univ-tours.fr/>)

Research team: RFAI (Pattern Recognition and Image Analysis: <http://www.rfai.li.univ-tours.fr/>)

Scientific direction:

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Duration: A full-time PhD student contract of 3 years, from 2010 1st of september approximately

Registration fees: The student must be registered as a PhD student at the François Rabelais University which cost 570€ a year, including social security and mutual insurance.

Financial support: This PhD thesis is proposed without salary and the student should come with its own financial support. For student from the PhD scholarships program of The Vietnam International Education Development (VIED) - project 322 - call 2009, we are studying the possibility to propose an extra-salary (please contact us for more details).

Social help: The candidate might be able to apply to student financial help for accommodation (ALE) (1% to 50% of the rent cost, see [here](#) for more details). Moreover for VIED's, administrative support (looking for accommodation, bank registration, etc.) could be provided by the non-profit institute touraine-vietnam.fr, please contact asso@touraine-vietnam.fr.

Host institution and place:

The Laboratory of Computer Sciences is composed by 30 Professors and Assistant Professors, 45 PhD and master students. The Lab is structured into five teams, whose researches concern the conception of performing algorithms for solving high combinatorial problems, providing decision aid and data mining. RFAI is second in the Lab in term of size, dedicated to activities in image processing and pattern recognition.

Rich with history and a well preserved heritage, Tours is a city of captivating charm. The urban area of Tours (of nearly 300 000 inhabitants) has a leading part to play in the Loire Valley. It lies at the crossroads of the North-South and East-West communication lines of Europe and is only one hour from Paris by high-speed train. Cost of living is attractive (a mean rate of 11.62€/m² for a month for an accommodation, see the [journal du net](#) for a comparative study of cities in France). More information about Tours could be found on ligeris.com.

Profile of the Candidate:

Requirements for the candidate are:

- A Master degree in Computer Science or Electrical Engineering.
- Good mathematics and programming skills are required.
- Past experiences in pattern recognition and image analysis are preferred.
- Good communication skills, with a.
- A fluent level in English is required ; some knowledge in French would be better, but not mandatory.

Description of the subject:

During past years, pattern recognition has been deeply studied and a wide range of theoretical and practical tools have emerged for extracting, representing and identifying pieces of information in images. Most of them are very efficient for specific or classical problems but there is still a lack for complex image analysis problems.

One way to fill this gap is to use several analyzing units, each one working on its own representation of the image and to make them collaborate to extract incrementally new pieces of knowledge. In this system approach, each level of information (from pixels to objects through area of interest) become new contextual information that could help identifying new objects, and localizing them better. This challenging issue is not yet well investigated. Research is either centered on system approaches for image processing on the one hand and, on the other hand, on multiple classifier systems combined to identify one kind of objects [1, 2, 3]. More global approaches mixing several levels of analysis and interpretation and that can collaborate are still unknown.

The aim of this thesis is to find original contributions to this complex problematic through the study of the following points:

- The fundamental of the collaboration process relies on the sharing of the data and their properties, that could be either part of the image itself, meta-data or models, or properties discovered thanks to the analyzing units. Consequently, one of the first task will be to elaborate a generic formalism to describe data (pixels, regions of interest, graphical primitives, objects ...) with their properties: features and labels with their imprecisions and confidence, contextual information such as graphical components around, meta-data ...
- Next, the decision process of a analyzing unit should be adapted to take into account all the contextual information available. The decision must depend on the properties of this information and specifically on its precision and confidence. Moreover, the analyzing units should be able to exploit information about themselves (reflexivity) such as ability to deal with input data, precision and confidence about their decision... These properties can be intrinsic to the component, *a-priori* information, or a consequence of a learning stage. In this last case, principals of classifier selection methods [4] and rejection process [5, 6] could be used with great advantage. Finally, the decision must be able to be refined or changed during the whole analyzing process, depending on the evolution of contextual information. This is this property that gives to the system its incremental analyzing capabilities. To manage in this challenging task, one possibility could be to take advantage of what already exists in multi-agent systems in artificial intelligence.

During all the thesis, a specific attention will be reserved to the use of validation and test protocols to confirm the generic aspect of the approach. Consequently, the methods will be tested on several problems that the RFAI research team is working on and especially on medical imaging and document analysis.

References:

- [1] D.M.J. Tax, M. van Breukelen, R.P.W. Duin, J. Kittler, "Combining multiple classifiers by averaging or by multiplying ?", *Pattern Recognition* 33, 1475-1485, 2000
- [2] Joydeep Ghosh, "Multiclassifier Systems: Back to the Future", *MCS 2002, LNCS 2364*, pp. 1-15, 2002
- [3] Nicolas Ragot, Eric Anquetil, "MELIDIS: Pattern recognition by intrinsic/discriminant dual modeling based on a hierarchical organization of fuzzy inference systems", in *10th International Conference on Information Processing and Management of Uncertainty in Knowledge-Based Systems, (IPMU'04)*, Volume 3, Pages 2069-2076, Perugia, Italy, Juillet 2004.
- [4] G. Giacinto, F. Roli, "Dynamic Classifier selection", *MCS 2000, LNCS 1857*, pp. 177-189, 2000
- [5] Harold Mouchère, Eric Anquetil, "A Unified Strategy to Deal with Different Natures of Reject", *In Proceedings of the International Conference on Pattern Recognition (ICPR'06)*, Pages 792-795, 2006.
- [6] Harold Mouchère, Eric Anquetil, Nicolas Ragot, « Etude et gestion des types de rejet pour l'optimisation de classifieurs », dans *15eme congrès francophone Reconnaissance des Formes et Intelligence Artificielle (RFIA 2006)*, Tours, France, Janvier 2006.