



PhD proposal

Measurement theory and robust estimators in discrete geometry

Domain: Computer Science

supervisors: Pr. Mohamed TAJINE, Dr. Étienne BAUDRIER and Dr. Loïc MAZO

Place: University of Strasbourg. **ICube UMR 7357** - 300 bd Sébastien Brant - CS 10413 - F-67412 Illkirch Cedex, FRANCE

Research team : MIV - Models, Images and Vision

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Key-words: Digital geometry, digital image, digital estimation, measure theory, integration theory

Funding: University of Strasbourg

Required profile : Holder of a Master's degree or an engineering degree with a good level in computer science and mathematics and a good ranking in the master's degree

Presentation of the PhD subject ([pdf](#))

In the context of scanned object image analysis, we seek to determine the conditions for a good estimation of the geometric information at all resolutions of the image. The ultimate goal is to design theories of measurement and integration for discrete spaces, such as $h\mathbf{Z}^n$, compatible with the theories of measurement and integration for Euclidean spaces.

Several classes of measurement estimators have already been developed (the local, semi-local, global estimators) [2-MB16, 5-DTZ11, 2-TD11, 1-Zou11, 2-DZT09]. The proposed work is, on the one hand, to study the behavior of the different estimators with respect to the transformation groups (typically displacements and homotheties) and, on the other hand, to design new multi-resolution estimators whose construction directly takes into account the transformation groups.

It should be noted that studies of the behaviors of digitizations with respect to transformation groups have been initiated for some digitization operators and certain of transformation groups [4-BM16, 5-MB16, 5-MB17].

This thesis is fundamental in nature but requires experimentation and algorithmic development. The recruited student should have a dual computer science and mathematics

profile and should therefore be at ease with mathematical formalisms and be a very good computer scientist.

References

- [2-MB16] : Loïc Mazo, Étienne Baudrier. *Non-local estimators: A new class of multigrid convergent length estimators*. Theor. Comput. Sci. 645. pp 128-146 (2016).
- [5-DTZ11] : Alain Daurat, Mohamed Tajine, Mahdi Zouaoui. *Les estimateurs semi-locaux de périmètre*. Rapport technique hal-00576881v1.
- [2-TD11] : Mohamed Tajine, Alain Daurat. *Patterns for multigrid equidistributed functions: Application to general parabolas and length estimation*. Theor. Comput. Sci. 412(36): 4824-4840 (2011).
- [1-Zou11]: Mahdi Zouaoui. *Mesures discrètes pour l'imagerie*. Thèse de doctorat de l'université de Strasbourg, 2011.
- [2-DZT09] : Alain Daurat, Mohamed Tajine, Mahdi Zouaoui. *About the frequencies of some patterns in digital planes. Application to area estimators*. Computers & Graphics 33(1): 11-20 (2009).
- [4-BM16] : Étienne Baudrier, Loïc Mazo. *Curve Digitization Variability*. DGCI LNCS Vol 9647pp 59-70 (2016).
- [5-MB16] : Loïc Mazo, Étienne Baudrier. *Object digitization up to a translation*. Rapport technique hal-01384377.
- [5-MB17] : Loïc Mazo, Étienne Baudrier. *Study on the digitization dual combinatorics and convex case*. Rapport technique hal-01497127.

The supervisor: Mohamed Tajine studied pure mathematics and Computer Science. He obtained his Ph.D. in 1992, specializing in logic and complexity theory. He has been Assistant professor since 1992 and then full Professor in Computer Science since 1999 at university of Strasbourg. His research interests are on combinatorics, digital geometry, fractal geometry, image synthesis, neural networks and proof theory. Since 1997, he is the head of the research group in digital geometry of the Laboratoire ICube UMR 7357-CNRS.

The laboratory: The laboratory [ICube](#) is respected internationally for its many important contributions in the field of Engineering and Computer Science. The laboratory ICube currently has more than 270 Academic/Academic Related staff and research staff and 140 PhD students. The State-funded Investissements d'Avenir's call for projects proved to be highly successful for the laboratory. Moreover, the laboratory ICube is member of 3 laboratories of excellence (Labex), including IRMIA in Theoretical Computer Science.

How to apply: Applicants should first email <tajine@unistra.fr> directly with one zip file "FirstName_LastName.zip" including the following:

1. CV (up to two pages, including GPA/ranking, IELTS/TOEFL if not native).
2. Personal statement (one page) including two referent email addresses.
3. Representative paper (indicating your skills/interest).

Qualified candidates will then be contacted for further consideration and the selected candidate will be guided through the formal application process. The target admission timeline is may 2017.