



Agència  
de Gestió  
d'Ajuts  
Universitaris  
i de Recerca

## **Memòria justificativa de recerca de les convocatòries BCC, BE, BP, CTP-AIRE, INEFC i PIV**

### **1.- Dades bàsiques i resums**

---

**Nom de la convocatòria**

**BP-B**

---

**Títol del projecte:** ha de sintetitzar la temàtica científica del vostre document.

Multi-scale label interaction to improve object detection and segmentation.

---

**Dades de l'investigador o beneficiari**

Nom	Cognoms
Carlo	Gatta

---

Correu electrònic  
carlo.gatta@ub.edu

---

**Dades del centre d'origen**

Universitat de Barcelona, Departament de Matemàtica Aplicada i Anàlisi

Gran Via de les Corts Catalanes 585  
08007 Barcelona

---

**Número d'expedient**

2009 BP-B 00205

---

**Paraules clau:**

Computer Science, Computer Vision, Machine Learning, Object segmentation, Object detection.

---

**Data de presentació de la justificació**

---

Nom i cognoms i signatura  
del/de la investigador/a

Carlo Gatta

Vist i plau del/de la responsable de la  
sol·licitud

Jordi Vitrià



Generalitat de Catalunya  
**Departament d'Economia  
i Coneixement**

---

**Resum del projecte:** cal adjuntar dos resums del document, l'un en anglès i l'altre en la llengua del document, on s'esmenti la durada de l'acció

---

**Resum en la llengua del projecte** (màxim 300 paraules)

The project aims at advancing the state of the art in the use of context information for classification of image and video data. The use of context in the classification of images has been showed of great importance to improve the performance of actual object recognition systems. In our project we proposed the concept of Multi-scale Feature Labels as a general and compact method to exploit the local and global context. The feature extraction from the discriminative probability or classification confidence label field is of great novelty. Moreover the use of a multi-scale representation of the feature labels lead to a compact and efficient description of the context.

The goal of the project has been also to provide a general-purpose method and prove its suitability in different image/video analysis problem. The two-year project generated 5 journal publications (plus 2 under submission), 10 conference publications (plus 2 under submission) and one patent (plus 1 pending). Of these publications, a relevant number make use of the main result of this project to improve the results in detection and/or segmentation of objects.

---

**2.- Memòria del treball** (informe científic sense limitació de paraules). Pot incloure altres fitxers de qualsevol mena, no més grans de 10 MB cadascun d'ells.

The report is structured in three parts: The first part list the achieved results on the main project topic; the second part shows the results obtained using the main project results on real problems of medical imaging; the last section gives an overview of side projects leaded by the researcher, collaborations, patents, etc.

### First part - Main Result:

The main project goal was to investigate on a novel methodology to improve object recognition/segmentation based on local and global context. The goal has been achieved proposing the "Multi-scale stacked sequential learning" (MRSSL) algorithm. The two main publications resulted are the following:

**AUTHORS:** C. Gatta, E. Puertas, O. Pujol

**TITLE:** *Multi-scale stacked sequential learning*

**JOURNAL/BOOK TITLE:** *Pattern Recognition*

**KEY:** A

**DATE OF PUBLICATION (\*):** *Volume 44, Issues 10-11, pp. 2414-2426, 2011.*

**MOST OUTSTANDING ASPECTS (\*\*):** *ISI Journal Citation Factor 3.279*

**AUTHORS:** O. Pujol, E. Puertas, C. Gatta

**TITLE:** *Multi-scale Stacked Sequential Learning*

**TYPE OF PRESENTATION:** *Oral*

**CONGRESS:** *8th International Workshop on Multiple Classifier Systems*

**PUBLICATION:** *MCS '09: Proceedings of the 8th International Workshop on Multiple Classifier Systems, Vol. 5519, pp 262-271*

**MEETING PLACE:** *Reykjavik (Iceland)*

**YEAR:** *2009*

Investigation on the topic is still ongoing. Actually I have implemented a multi-class version, which allows limiting the computational burden with respect to the original method. Preliminary results shows that the method can outperform the Discriminative Random Field and the Decision Tree Fields on complex problems, while being computationally more efficient. Test on the Microsoft MSRC\_ObjCategImageDatabase\_v2 dataset are ongoing. Up to now the method outperforms all but two of the state of the art methods. And outperforms all of the state of the art methods providing pixel-wise classification. A journal paper on the topic is almost ready, and will be submitted to the International Journal of Computer Vision, a highly respected journal with I.F: 5.15 (2010 – first quartile).

### Second part – Application to medical imaging problems:

The "*Multi-scale stacked sequential learning*" has been tested, in the original paper on two problems: text classification and object (horses) segmentation, providing state-of-the-art results. Nonetheless, we fruitfully applied the method to other segmentation/detection topics. The following subsections provide a brief explanation of each topic and the related publication(s).

#### Medical Intravascular Sequences:

In medical imaging, especially in Intravascular Ultrasound (IVUS), the appearance of a given tissue can vary a lot and present strong ambiguities with other tissues. Medical doctor, while inspecting this kind of data, make explicit use of the context information, as a prior on what they expect to see, but also on spatial relationship with other tissue. We employed the MRSSL on a detection and a segmentation problem.

**AUTHORS:** Marina Alberti, Carlo Gatta, Simone Balocco, Francesco Ciompi, Oriol Pujol, Joana Silva, Xavier Carrillo, and Petia Radeva

**TITLE:** *Automatic Branching Detection in IVUS Sequences*

**JOURNAL/BOOK TITLE:** *Lecture Notes In Computer Science*

**KEY:** CB

**DATE OF PUBLICATION (\*):** *Vol. 6669, Pages 126-133, 2011*

**AUTHORS:** Alberti, M., Balocco, S., Gatta, C., Ciompi, F., Pujol, O., Silva, J., Carrillo, X., Radeva, P.

**TITLE:** *Automatic Bifurcation Detection in Coronary IVUS Sequences*

**JOURNAL/BOOK TITLE:** *IEEE Transaction on Biomedical Engineering*

**KEY:** A

**DATE OF PUBLICATION (\*):** *in press*

*AUTHORS: Francesco Ciompi, Oriol Pujol, Carlo Gatta, Marina Alberti, Simone Balocco, Xavier Carrillo, Josepa Mauri-Ferre and Petia Radeva*

*TITLE: HolIMab: a Holistic approach for Media-Adventitia border detection in Intravascular Ultrasound*

*JOURNAL/BOOK TITLE: Medical Image Analysis (Elsevier)*

*KEY: A*

*DATE OF PUBLICATION (\*): under revision*

*MOST OUTSTANDING ASPECTS (\*\*): ISI Journal Citation Factor 4.521*

#### **X-Ray Angiography images and sequence:**

X-Ray angiography is widely used in the diagnosis of cardiac diseases and to assist cardiovascular interventions. We employed the MRSSL in the accurate detection of the catheter guide to distinguish it from the arteries based only on geometrical properties. Moreover, we used the MRSSL to identify region of interest in myocardial perfusion sequences; for this latter project, we are in the process of patenting an invention based upon our method, so that no publication on the topic have been achieved up to now. The project is supported by a VALOR grant.

*AUTHORS: A. Hernandez-Vela, C. Gatta, S. Escalera, L. Igual, V. Martin-Yuste, and P. Radeva*

*TITLE: Accurate and robust fully automatic QCA: Method and numerical validation*

*JOURNAL/BOOK TITLE: Lecture Notes In Computer Science*

*KEY: CB*

*DATE OF PUBLICATION (\*): Vol. 6893 (3), Pages 496-503, 2011*

*MOST OUTSTANDING ASPECTS (\*\*): This is the proceeding of the MICCAI conference.*

*AUTHORS: Antonio Hernández-Vela, Carlo Gatta, Sergio Escalera, Laura Igual, Victoria Martín-Yuste, Manel Sabaté, and Petia Radeva*

*TITLE: Accurate centerline extraction, caliber estimation and catheter detection in X-Ray angiography*

*JOURNAL/BOOK TITLE: IEEE TITB*

*KEY: A*

*DATE OF PUBLICATION (\*): under revision*

### **Thirs part – Publications, patents and projects:**

#### **Publications (not mentioned in previous subsections):**

*AUTHORS: S. Balocco, C. Gatta, O. Pujol, J. Mauri Ferre, P. Radeva*

*TITLE: "SRBF: Speckle Reducing Bilateral Filtering"*

*JOURNAL/BOOK TITLE: Ultrasound in Medicine and Biology*

*KEY: A*

*DATE OF PUBLICATION (\*): Volume 36, No. 8, pp. 1353-1363, 2010.*

*MOST OUTSTANDING ASPECTS (\*\*): ISI Journal Citation Factor 2.395*

*AUTHORS: F. Ciompi, O. Pujol, C. Gatta, O. Rodríguez Leor, J. Mauri Ferré, P. Radeva*

*TITLE: Fusing in-vitro and in-vivo IVUS data for plaque characterization*

*JOURNAL/BOOK TITLE: International Journal of Cardiovascular Imaging*

*KEY: A*

*DATE OF PUBLICATION (\*): Volume 26, Issue 7, pp 763-779, 2010*

*MOST OUTSTANDING ASPECTS (\*\*): ISI Journal Citation Factor 1.268*

*AUTHORS: F. Ciompi, C. Gatta, O. Pujol, O. Rodríguez-Leor, J. Mauri Ferré, P. Radeva*

*TITLE: Reconstruction and Analysis of Intravascular Ultrasound Sequences*

*JOURNAL/BOOK TITLE: Recent Advances in Biomedical Signal Processing*

*KEY: CB*

*DATE OF PUBLICATION (\*): Pages 223 – 243, 2010, Bentham Science Publishers*

*AUTHORS: C. Gatta, S. Balocco, F. Ciompi, R. Hemetsberger, O. Rodríguez Leor, and P. Radeva*

*TITLE: Real-Time Gating of IVUS Sequences Based on Motion Blur Analysis: Method and Quantitative Validation*

*JOURNAL/BOOK TITLE: Lecture Notes In Computer Science*

*KEY: CB*

*DATE OF PUBLICATION (\*): Vol. 6362, Part II, Pages 59-67, 2010*

*MOST OUTSTANDING ASPECTS (\*\*): This is the proceeding of the MICCAI conference.*

*AUTHORS: S. Balocco, C. Gatta, F. Ciompi, O. Pujol, X. Carrillo, J. Mauri, P. Radeva*

*TITLE: Combining Growcut And Temporal Correlation For IVUS Lumen Segmentation*

*JOURNAL/BOOK TITLE: Lecture Notes In Computer Science*

*KEY: CB*

*DATE OF PUBLICATION (\*): Vol. 6669, Pages 556-563, 2011*

*AUTHORS: C. Gatta, S. Balocco, V. Martin-Yuste M.D., R. Leta M.D. and P. Radeva*

*TITLE: Non-rigid multi-modal registration of coronary arteries using SIFTflow*

*JOURNAL/BOOK TITLE: Lecture Notes In Computer Science*

*KEY: CB*

*DATE OF PUBLICATION (\*): Vol. 6669, Pages 159-166, 2011*

*AUTHORS: Francesco Ciompi, Oriol Pujol, Carlo Gatta, Xavier Carrillo, Josepa Mauri and Petia Radeva*

*TITLE: A holistic approach for the detection of media-adventitia border in IVUS*

*JOURNAL/BOOK TITLE: Lecture Notes In Computer Science*

*KEY: CB*

*DATE OF PUBLICATION (\*): Vol. 6893 (3), Pages 411-419, 2011*

*MOST OUTSTANDING ASPECTS (\*\*): This is the proceeding of the MICCAI conference.*

*AUTHORS: E. Serradel, A. Romero, R. Leta, C. Gatta, F. Moreno-Noguer*

*TITLE: Simultaneous Correspondence and Non-Rigid 3D Reconstruction of the Coronary Tree from Single X-ray Images*

*TYPE OF PRESENTATION: Poster*

*CONGRESS: 13th International Conference on Computer Vision (ICCV 2011)*

*PUBLICATION: accepted*

*MEETING PLACE: Barcelona (Spain)*

*YEAR: November 2011*

*MOST OUTSTANDING ASPECTS (\*\*): ICCV is one of the three most important conference on computer vision.*

*AUTHORS: P. Martins, C. Gatta and P. Carvalho*

*TITLE: Feature-Driven Maximally Stable Extremal Regions*

*TYPE OF PRESENTATION: Poster*

*CONGRESS: VISAPP 2012*

*PUBLICATION: accepted*

*MEETING PLACE: Rome (Italy)*

*YEAR: February 2012*

#### **Patents:**

*INVENTORS (in order of authorship): Carlo Gatta, Petia Ivanova Radeva, Josepa Mauri i Ferré, Oriol Pujol i Vila, Oriol Rodriguez, David Rotger, Eduardo Fernandez-Nofrerias, Francesco Ciompi*

*TITLE: SYSTEMS AND METHODS FOR PERFORMING AN IMAGE-BASED GATING PROCEDURE DURING AN IVUS IMAGING PROCEDURE*

*PUBLICATION No: US 2011/0096972 A1*

*PRIORITY COUNTRY: United States of America*

*PUBLICATION DATE: April 28, 2011*

*APPLICATION No: 12/898,437*

*FILED: October 5, 2010*

*HOLDER ENTITY: Boston Scientific SciMed, Inc.*

*OTHER COUNTRIES WHICH THE PATENT HAS BEEN EXTENDED TO:*

*COMPANIES THAT ARE LICENSING IT:*

Systems and methods for detecting and displaying body lumen bifurcations

**[PENDING]**

M. Alberti, S. Balocco, C. Gatta, F. Ciompi, O. Pujol, X. Carrillo, J. Mauri-Ferre, P. Radeva, O. Rodriguez, E. Fernandez-Nofrerias

61/510,014

United States of America – Boston Scientific Corporation Boston Scientific Corporation

#### **Projects:**

I am the I.P. of the project "X-QPA: a Quantitative X-Ray-based intra-operative myocardial re-Perfusion computer-assisted Analysis/diagnosis tool", supported by AGAUR/ACC10 with a VALOR grant (VALOR 158 – 2010).