

# Sylvie Chambon

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French citizen, born on February 10Th, 1979, in Toulouse, France, married

PROFESSIONAL ADDRESS

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## EDUCATION

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**December 2005**

PhD in Computer Science of University of Paul Sabatier, UPS (with [équipe Traitement et Compréhension d'Images](#), TCI, of [Institut de Recherche en Informatique de Toulouse](#), IRIT).

**June 2002**

Master of Computer Science and Image, UPS.

**June 2000**

Bachelor in Computer Science, UPS.

## RESEARCH

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**Image processing**

This work concerns *automatic detection* of damages, and particularly *cracks*, in *road images*. This task is difficult because cracks are fine structures hard to distinguish from the background, the pavement. This is why we investigate methods based on two steps: extraction with *adapted filter* followed by a refinement with *Markov Random Field segmentation*.

**Computer vision**

This work is about *matching* in *stereo vision*. Three steps are necessary to estimate the third dimension of a scene: calibration, matching and 3D reconstruction. The quality of 3D reconstruction depends on the quality of matching. Most of the matching methods are based on a similarity criterion or *correlation measure*. We are particularly concern with the correlation-based matching methods that can take into account the *color* information and the *occlusion problem*.

**Medical imaging**

This work involves *registration* between *CT volumes* (Computed Tomography) and *PET volumes* (Positron Emission Tomography). In the context of *lung oncology*, precise localisation and tracking of tumors is needed. This is why we are particularly working with the introduction of a *breathing model* in a *non linear registration with rigidity constraints*.

**December 2007***Automatic detection of cracks of the roads*

In the context of automatic detection of cracks in road images, these methods have been developed: thresholding, using morphological tools, neuron networks and wavelet transform combined with Markov random field-based segmentation. The last category allows robustness to the size of the cracks. However, existing methods do not take into account 2D adapted filter and use a constant function for the crack modelling. It is not realistic. With the collaboration of Peggy SUBIRATS, at the *Centre d'Études Techniques de l'Équipement (CETE)*, Rouen, France, improvements have been proposed to model a 2D adapted filter and a new designing of the sites of the Markov random field. This work will be published in [4].

**September 2006***Matching by propagation of seeds*

Global matching methods are efficient because they take into account global constraints and, so, for example, they can alleviate the problem of untextured areas on the contrary of local matching methods. A lot of global methods are based on an first partial matching of point of interest. Detect and select these points is important for the performance of these methods. We are working on global methods based on seeds correspondences. These seeds are determined with the disparity map obtained by a local matching method (one of the robust matching methods proposed in the thesis work). This work is realised in collaboration with Alain CROUZIL, at the university of Paul Sabatier, in Toulouse and a master student Guillaume GALÈS.

**April 2007***Color global matching*

Global matching methods with dynamic programming or graph cuts are very popular and give good results (see the evaluation protocol of Scharstein and Szeliski :

<http://bj.middlebury.edu/~schar/stereo/newEval/php/results.php>).

Actual methods do not take into account color and the aim of this work with Michael BLEYER, researcher at *Institute for Software Technology and Interactive Systems*, in *Interactive Media Systems*, Vienna, en Austria, is to introduce methodologies for adapting global methods to color and to propose an evaluation protocol in order to compare different global methods with color. This work has been first published in [5].

**April 2006***Generalised Thin-Plate Spline*

Thin-Plate Spline, TPS, are useful for modelling deformation between two scenes composed of deformable objects. These methods, based on TPS, are not rigid, i.e. they do not respect the epipolar constraint, and, consequently, they can not model perspective deformations. Three new TPS-based methods are proposed: rigid TPS (the epipolar constraint is respected), perspective TPS (perspective deformations are taken into account) and rigid-perspective TPS. This work is achieved with Adrien BARTOLI, CNRS, LASMEA, Clermont-Ferrand, and has been published in [8]. We want to extend these methods to registration of medical images.

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- Project** MARIO – Modélisation de l’Anatomie normale et pathologique pour le Recalage non linéaire entre Images CT et TEP en Oncologie.
- Date** September 2006.
- Participants** Isabelle BLOCH (responsable), Antonio MORENO, Elsa ANGELINI, in **collaboration** with Anand SANTHANAM and Jannick ROLLAND, CREOL-ODALab, University of Central Florida, Orlando, United-States.
- Abstract** This work was supported by a grant from ANR (French Agency for Research) for the project MARIO (Modélisation de l’Anatomie normale et pathologique pour le Recalage non linéaire entre Images CT et TEP en Oncologie). In the context of thoracic images, our goal is to propose methods in order to locate and track tumors of the lungs precisely for oncological applications. PET and CT volumes provide complementary information for these applications. However, CT/PET registration is difficult. The method is based on a first segmentation of the lungs in the PET and the CT volumes. Then, the registration follows these steps:
- Compute the rigid transformation between the tumors in CT and in PET;
  - Define and select points of interest (landmarks) on the surface of the lungs;
  - Compute the transformation between the PET and the CT volumes by using constraints on the tumors (rigid elements) and the landmarks correspondences.
- For the selection of landmarks, we used the mean and the Gaussian curvatures: voxels with high curvatures are selected. In order to obtain a uniform selection, we also added voxels of interest in the areas with non-zero curvatures (flat areas). To obtain a realistic deformation between the PET and the CT volumes, we introduced a breathing model in the registration process. CT volumes, in fact meshes, are simulated at different instants of the breathing cycle and the closest CT mesh to the PET mesh is selected. The transformation between the original CT and the PET volumes is computed with the registration between the closest CT and the original PET (estimated with the Iterative Closest Point, ICP, algorithm) and the registration between the closest CT and the original CT (given by the breathing model). Consequently, the introduction of the breathing model allows to obtain more realistic correspondences between landmarks on the CT and the PET volumes.

**Publications** This work has been published in [1,6,7].

#### THESIS

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- Title** Correlation-based matching of color images with occlusions.
- Date** 14Th of December 2005 at University of Paul Sabatier – Toulouse III.
- Director** Alain CROUZIL, UPS, Toulouse
- Examiners** Xavier DESCOMBES, Frédéric JURIE, Patrice DALLE, Jean-José ORTEU, Jean-Yves TOURNERET
- Abstract** This work deals with stereo-vision and more precisely matching of pixels using correlation measures. Matching is an important task in computer vision, the accuracy of the three-dimensional reconstruction depending on the accuracy of the matching. The problems of matching are: intensity distortions, noises, untextured areas, foreshortening and occlusions. Our research concerns matching color images and takes into account the problem of occlusions.
- First, we distinguish the different elements that can compose a matching algorithm. This description allows us to introduce a classification of matching methods into four families: local methods, global methods, mixed methods and multi-pass methods.

**Abstract** Second, we set up an evaluation and comparison protocol based on fourteen image pairs, five evaluation areas and ten criteria. This protocol also provides disparity, ambiguity, inaccuracy and correct disparity maps. This protocol enables us to study the behavior of the methods we proposed.

Third, forty correlation measures are classified into five families: cross-correlation-based measures, classical statistics-based measures, derivative-based measures, non-parametric measures and robust measures. We also propose six new measures based on robust statistics. The results show us the most robust measures near occlusions: the robust measures including the six new measures.

Fourth, we propose to generalize dense correlation-based matching to color by choosing a color system and by generalizing the correlation measures to color. Ten color systems have been evaluated and three different methods have been compared: to compute the correlation with each color component and then to merge the results; to process a principal component analysis and then to compute the correlation with the first principal component; to compute the correlation directly with colors. We can conclude that the fusion method is the best.



Finally, in order to take into account the problem of occlusions, we present new algorithms that use two correlation measures: a classic measure in non-occluded area and a robust measure in the whole occlusion area. We introduce four different methods: edge detection methods, weighted correlation methods, post-detection methods and fusion method. This latter method is the most efficient.

**Publications** Each step of this work has been published in [2,3,9,10,11].



## PUBLICATIONS OF SYLVIE CHAMBON






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### International journal

- [1] Antonio Moreno, Sylvie Chambon, Anand P. Santhanam, Jannick P. Rolland, Elsa Angelini, Isabelle Bloch. "Combining a breathing model and tumor-specific rigidity constraints for registration of CT-PET thoracic data". *Computer Aided Surgery, CAS*, volume 13, issue 5, pages 281–298, September 2008. 
- [2] Sylvie Chambon, Alain Crouzil. "Occlusions handling in dense stereo matching". *Image and Vision Computing*, Elsevier, March 2007. Submitted.
- [3] Sylvie Chambon, Alain Crouzil. "Colour correlation-based matching". *International Journal of Robotics and Automation*, IASTED, volume 20, issue 2, pages 78–85, 2005. 

### International conferences

- [4] Sylvie Chambon, Peggy Subirats, Jean Dumoulin. "Introduction of a wavelet transform based on 2D matched filter in a Markov Random Field for fine structure extraction: Application on road crack detection", *IS&T/SPIE Electronic Imaging - Image Processing: Machine Vision Applications II*, San Jose, United States, January 2009. To appear.
- [5] Michael Bleyer, Sylvie Chambon, Uta Poppe, Margrit Gelautz. "Evaluation of different methods for using colour information in global stereo matching approaches". In *The Congress of the International Society for Photogrammetry and Remote Sensing, Beijing, China*, July 2008. To appear. 
- [6] Antonio Moreno, Sylvie Chambon, Anand P. Santhanam, Roberta Brocardo, Jannick P. Rolland, Elsa Angelini, Isabelle Bloch. "Thoracic CT-PET Registration Using a 3D Breathing Model". *International Conference on Medical Image Computing and Computer Assisted Intervention – MIC-CAI, Brisbane, Australia*, Part I, LNCS 4791, pages 626-633, October 2007. 

- [7] Sylvie Chambon, Antonio Moreno, Anand P. Santhanam, Jannick P. Rolland, Elsa Angelini, Isabelle Bloch. "CT-PET Landmark-based Registration Using a Dynamic Lung Model". *International Conference on Image Analysis and Processing – ICIAP, Modena, Italy*, pages 691–696, September 2007. 
- [8] Adrien Bartoli, Mathieu Perriollat, Sylvie Chambon. "Generalized Thin-Plate Spline Warps". *Computer Vision and Pattern Recognition - CVPR, Minneapolis, United-States*, June 2007. To appear. 
- [9] Sylvie Chambon, Alain Crouzil. "Color stereo matching using correlation measures". *Complex Systems Intelligence and Modern Technological Applications - CSIMTA, Cherbourg, France*, October 2007, September 2004. 
- [10] Sylvie Chambon, Alain Crouzil. "Towards correlation-based matching algorithms that are robust near occlusions". *International Conference on Pattern Recognition - ICPR, Cambridge, United-Kingdom*, IAPR, p. 20–23, vol. 3, August 2004. 
- [11] Sylvie Chambon, Alain Crouzil. "Dense matching using correlation: new measures that are robust near occlusions". *British Machine Vision Conference - BMVC, Norwich, United-Kingdom*, IAPR, p. 143–152, September 2003. 

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## RESEARCH ACTIVITIES

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### REVIEWING

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<b>August 2008</b>	Syntactical and Structural Pattern Recognition and Statistical Pattern Recognition, S+SSPR.
<b>July 2008</b>	Revue Information – Interaction – Intelligence, I <sup>3</sup> .
<b>May 2008</b>	Electronic Letters on Computer Vision and Image Analysis, ELCVIA.
<b>September 2007</b>	IEEE Pacific Rim Symposium on Image Video and Technology, PSIVT.
<b>January 2007</b>	IEEE Computer Vision and Pattern Recognition, CVPR.
<b>December 2006</b>	Computer Vision and Image Understanding, CVIU, Elsevier.
<b>September 2006</b>	Image and Vision Computing, IVC, Elsevier.

### MASTER STUDENTS

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<b>2007–2008</b> Nantes LCPC, MI, IG	Noémie VANETTI. It concerns geolocalisation of defaults on civil structures in images acquired from a UAV (Unmanned Air Vehicle). This work consists in the proposition of a methodology in order to set a building site, the improvements of the method for detecting the defaults by photogrammetry and the designing of a protocol of tests in order to quantify the accuracy of the system.
<b>2006–2007</b> Paris ENST, TSI	Roberta BROCARDO. Her work concerns the MARIO project, in particular, the segmentation of the lungs and the evaluation of the integration of the breathing model in the registration process.
<b>2006–2007</b> Toulouse IRIT, TCI	Guillaume GALÈS. <i>Global matching with points of interest.</i> Two types of matching methods exist: global and local. Some global methods are based on an initial matching of points of interest. These points are reliable corresponding points. The aim of this work is to propose a new state of the art and analysis of the performance of methods for selecting these points of interest. Finally, we propose global matching based on point of interest detection.

## MASTER STUDENTS

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- 2004–2005** Benoît BOCQUILLON.  
Toulouse  
IRIT, TCI  
*Stereo images with ground truth.* In order to accurately evaluate matching methods, we need an evaluation and comparison protocol. So we have to determine : the images that can be tested, the criteria that will be evaluated, how we can made the synthesis of the results in order to propose a classification and the methods that would be compared. Until now, our evaluation only use images from Scharstein and Szeliski . We have proposed a new semi-automatic method with plane-based segmentation in order to obtain accurate images with ground truth. This new data can be downloaded: <http://www.irit.fr/~Benoit.Bocquillon/MYCVR/research.php>.

## SEMINARS

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- 2007–2008** Seminars for presentation of the research work before working in LCPC in Nantes and Paris, and, also in the regional laboratory in Strasbourg.
- 2006–2007** In the medical team at ENST about:  
Thesis work.  
Point of interest detection.  
Breathing models in medical imaging.  
Discussions about important publications in medical imaging.
- 2003–2006** Organisation member and reviewer of colloquium of PhD students of University of Paul Sabatier, Toulouse.

## INVITED SEMINARS

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- Nantes IRCCyN, Institut de Recherche en Communications et en Cybernétique de Nantes, in team, IVC, Image Vidéo Communication.
- Lyon LIRIS, Laboratoire d'InfoRmatique en Images et Systèmes d'information.
- Paris IEF, Institut d'Électronique Fondamentale.  
PRC/LISIF, Perception et Réseaux Connexionnistes/Laboratoire des Instruments et Systèmes de l'Ile-de-France.
- Le Creusot Le2I, Laboratoire Électronique, Informatique et Image.

## CONFERENCES

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- September 2004** *Complex Systems Intelligence and Modern Technological Applications, CSIMTA*  
Cherbourg 2004, for an oral presentation of " *Color stereo matching using correlation measures* ".
- August 2004** *International Conference on Pattern Recognition, ICPR 2004*, for an oral presentation of " *Towards correlation-based matching algorithms that are robust near occlusions* ".
- September 2003** *British Machine Vision Conference, BMVC 2003*, for a poster presentation of " *Dense matching using correlation: new measures that are robust near occlusions* ".

TEACHING

<i>Year, place</i>	<i>Classes</i>	<i>Levels</i>	<i>Hours</i>
2006/2007, Paris	OCaml	Bachelor	13
2001–2006, Toulouse	Computer vision and image processing	Master	40
	Multimedia systems	Master	8
	Prolog	Bachelor	13
	C	Bachelor	82
	Caml	Bachelor	166
	Systems	Bachelor	16
		ALL	338

COMPUTER SCIENCE COMPETENCES

<b>Programming languages</b>	C, Caml, Scheme, Java, Ada, Pascal, Shell, HTML.
<b>Operating Systems</b>	Unix, Linux, Windows.
<b>Mathematics</b>	Matlab.
<b>Data base</b>	SQL, PL/SQL, O2.
<b>Specification</b>	UML.
<b>Others</b>	L <sup>A</sup> T <sub>E</sub> X, StarWriter, StarCalc, Word, Excel, Powerpoint.

LANGUAGES

<b>French</b>	Mother tongue.
<b>English</b>	First foreign language at secondary school. DULS, University Diploma in Scientific English, June 2003. DULAP, University Diploma in Practical English, June 2004.
<b>Others</b>	Spanish, Portuguese.