

PhD Thesis proposal in the field of Signal and Image processing

"Automatic Segmentation and Recognition of Human Actions in Monocular Sequences. Application to safety/security in public transport"

3 years Doctoral contract

Deadline for application : 2016 February 19th

Effective date of the contract : autumn 2016

Description of the project

In public transport, reducing the feeling of insecurity of people travelling there, needs to reduce the risk of aggression or the risk for people to be witness of an aggression. The solution adopted by the public transport operators is the deployment of human agents and on an important CCTV coverage in the stations and onboard vehicles.

Some surveys carried out by the Public Transport Union, international organisation, has concluded that the majority of aggressions take place onboard vehicles.

Nowadays, CCTV surveillance with video sensors is installed inside in one bus over two and in more than two vehicles over three in metros, trams and trolley buses.

The increasing number of onboard cameras installed lead to a make very difficult the work of visualizing everything by transport personnel in the control rooms. That is why the research and development of an automatic surveillance help is an important issue.

This work will focus on the investigation, implementation and evaluation of computer vision methods capable of monitoring and detecting human behaviour (individual actions and interactions) in situations of close (near) camera views (here in CVs), specially those with varying illumination environments that will be typical of many future autonomous visual observation systems.

The focus of study is on-board environments typical of public transport networks (trains, buses, metros) where there is a societal need to increase the use of public transport, by making such systems more attractive to the public from a security and a safety point of view.

The PhD work will consist in bringing effective advancements in pedestrians detection and on some actions recognition in very constrained environments. Progress is still needed in the following main areas :

- Detection of people and their silhouettes (outlines+body) from which to extract features indicative of actions, such as visual hulls , optical flow, poses , etc.
- Tracking and Recognition of elemental single-person actions (e.g. walking, running, jumping) and then simple behaviours such as “turning left” and “aggression”
- Recognition of complex interactions between two or more people such as “talking to each other”, “mobile phone stealing”. A specific user needs analysis will be carried out with the Toulouse transport operator (Tisseo).

This work is part of the ESAD-ZELT team working program at Cerema Toulouse. It represents a close collaboration between Cerema Institute, Paul Sabatier University in Toulouse and Carlos III University in Madrid.

Some specific technical experts from Toulouse transport operator (Tisseo) will be involved to refine the safety/security user needs analysis.

Some references of the PhD supervisors :

C. Salvadori, M. Petracca, J. Martinez del Rincon, S. A. Velastin, D. Makris. An optimisation of Gaussian mixture models for integer processing units. *Journal of Real Time Image Processing*, pp. 1–17, 2014.

D. Simonnet, M. Lewandowski, S. A. Velastin, J. Orwell, E. Turkbeyler. Tracking pedestrians in crowded scenes using dynamic time-warped appearance features. Workshop on Pattern Recognition and Crowd Analysis. *International Conference on Pattern Recognition*, 2012.

S. Singh, S. A. Velastin, H. Ragheb. MuHAVi: A multicamera human action video dataset for the evaluation of action recognition methods. *IEEE International Conference on Advanced Video and Signal Based Surveillance*, 2010.

L. Khoudour, D. Aubert, S. Velastin, V. Leung, J. Orwell, "Video-based detection of specific events in public transport networks", *Revue Studia Informatica Universalis* vol. 8, Number 4, Hermann Editor, pp 58-88, 2010

S. Pedagadi, J. Orwell, S. A. Velastin. Local Fisher Discriminant Analysis for Pedestrian Re-identification. *IEEE Conference on Computer Vision and Pattern Recognition*, 2013.

H. Salmane, L. Khoudour, Y. Ruichek, "A video analysis based system for detecting hazard situations at level crossings », *IEEE Transactions on Intelligent Transportation Systems*, special Issue« Next generation of rail transportation ». DOI : 10.1109/TITS.2014.2331347 , janvier 2015

H. Salmane, Y. Ruichek, L. Khoudour "A novel evidence based model for detecting dangerous situations in level crossing environments", *International Journal of Expert systems with applications*, <http://dx.doi.org/10.1016/j.eswa.2013.08.010>

D.N. Truong Cong, L. Khoudour, C. Achard, J.L. Bruyelle "Intelligent distributed surveillance system for people re-identification in transport environment " *Journal of Intelligent Transportation systems*, Published By: Taylor & Francis, volume 15, DOI: 10.1080/15472450.2011.594672

D.N. Truong Cong, L. Khoudour, C. Achard, L. Douadi, " People detection and reidentification in complex environments", *IEICE Transactions on Information and Systems, Special Issue on Machine Vision and Applications* Vol.E93-D,No.7, pp 1761-1772 ,July 2010.

Desired skills

The applicant would have to show good competences in signal and image processing, in applied mathematics and in data processing. He (she) will have also have good knowledge in C/C++ programming. He (she) must have good oral and written knowledge in French and English languages.

Stay conditions for the PhD student

- The Phd student will be employed by Cerema institute for a 3 years contract from autumn 2016 to autumn 2019 (exact dates will be fixed with the student)
- The project will be developed mainly in the Cerema Toulouse premises among ESAD-ZELT team :
Cerema DterSO, 1 avenue du Colonel Roche, 31400 Toulouse (Complexe scientifique de Rangueil)

Close to Paul Sabatier University, the registration of the student will made at the doctoral school **MITT : Mathématiques, Informatique, télécommunications de Toulouse**

Supervision team of the PhD project

The PhD work will be supervised by Dr Louahdi Khoudour (Head of ESAD-ZELT laboratory), and will be co-advised by Dr Alain Crouzil, associate professor at Paul Sabatier University and Pr Sergio Velastin from Carlos III University in Madrid.

Procedure for application

The candidate is invited to join the main contact in Cerema :

Dr Louahdi KHOUDOUR,
CEREMA/DTerSO/Dalet, 1 avenue du Colonel Roche 31400 Toulouse, France
louahdi.khoudour@cerema.fr
Tel +33 5 62 25 97 84, +33 6 78 18 57 71

The applicant must send to Dr Louahdi Khoudour the application form by email no later than february 19th 2016 with the following documents :

- CV of the candidate
- Identification card or passport scan copy
- Marks of the Master diploma (at least marks for Master 1 if Master 2 marks are not still available)
- Scan copy of the last diploma (Master 1, engineer school, Master 2 if already obtained)
- A motivation letter from the applicant explaining the interest for the subject (1 page recto-verso maximum).
- A recommendation letter.