



Image Processing and Pattern Recognition Research Center of the Technical University of Cluj-Napoca, Romania

The Technical University of Cluj-Napoca is a 100-year old institution of higher technical education based in the city of Cluj-Napoca, in the heart of Transylvania, Romania. The University offers all levels of degree education in multiple technical fields, including Computer Science and Engineering. Currently, there are more than 20000 students enrolled with TUCN.

The Image Processing and Pattern Recognition Research Center (IPPRRC) was set up in 1998 as an independent research team within the Computer Science Department of TUCN leveraging expertise in hardware design and software integration, signal and image processing and pattern recognition.

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Three years later, Prof. Nedeveschi and a young research team started a fruitful cooperation with the research division of Volkswagen AG, Germany, in the field of stereovision applied to driving assistance. The initial research agreement SCABOR—Stereo Camera Based Object Recognition, a one year contract, was followed by more than 12 research contracts, for more than 10 years, with multiple scientific and technological achievements.

Today, IPPRRC is a powerful research team consisting of four senior and 8 junior faculty members with eleven graduate students.

Mission and Research Areas

The IPPRRC is involved in multiple computer vision related research



subjects, a significant part of the effort being directed to finding original, robust and fast solutions for environment perception for Intelligent Transportation Systems. Real time stereovision has been the focus of the team since 2001, significant result being achieved in developing new techniques for feature extraction, stereo matching, camera calibration, hardware based optimization. Based on stereovision, original solutions for environment perception are being developed, such as obstacle detection and tracking, road and lane tracking, object classification. Recently, the group's research in the field of ITS expanded beyond classic stereo environment perception, tackling fundamental problems such as new environment modeling techniques and vision-map-GNSS information fusion for accurate positioning.

The research activity of IPPRRC is not limited to the ITS field. Other applications of stereovision



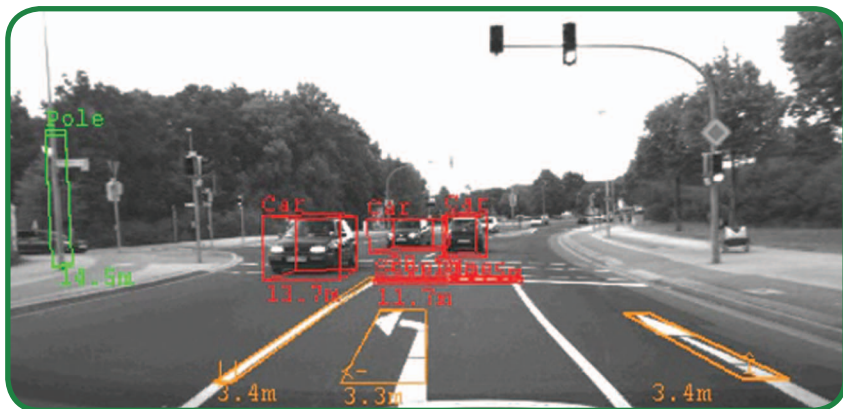
People of IPPRRC meeting with the partners from Volkswagen AG, in the framework of the INTERSAFE-2 FP7 project (August 2009, at the ICCP 2009 conference in Cluj-Napoca).



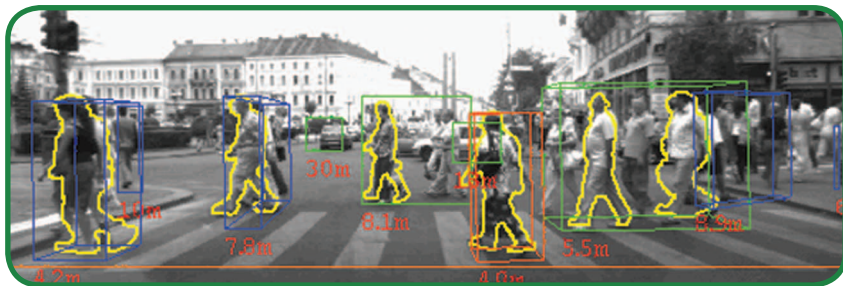
Dense stereovision through GPU optimized eight direction semiglobal matching (SGM).



Variational optical flow for highly dynamic environments, GPU optimized for real time performance.



Object detection, tracking and classification in urban driving environments.



Pedestrian classification.

include environment perception for indoor robot navigation, and wide baseline stereovision for the surveillance of space. The research team is also involved in medical image processing for computer assisted diagnosis, automatic image annotation, real-time optical flow computation, omnidirectional stereovision, and

FPGA hardware systems design for real time image processing.

Research Projects

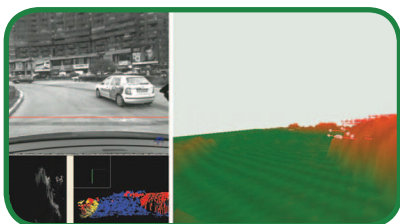
The research activity of IPPRRC is funded by national, European and private research projects. The initial collaboration with Volkswagen, started in 2001 through the SCABOR

project and culminated with the FP7 European project “Cooperative Intersection Safety—INTERSAFE-2” (2008–2011).

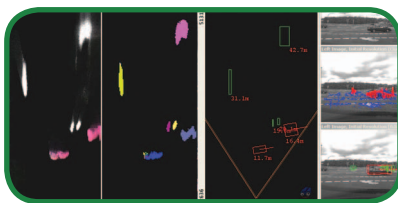
After the success of the participation in INTERSAFE-2, the team was involved in other European FP7 projects: “The Large Knowledge Collider—LARCK”, “Incentives for semantic—INSEMTIVES”, or “Accelerate Cooperative Mobility—DRIVE-CX”.

The team is currently involved in two FP7 European projects, four national projects financed by the Romanian Authority of Scientific Research, and some research contract with industrial partners:

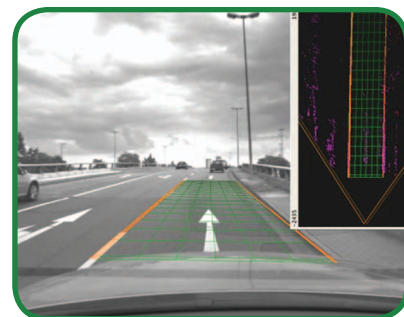
- “Plug and Navigate ROBOTS for smart factories—PAN-ROBOTS”, European FP7 project (2012–2015), aims to develop, demonstrate and validate a generic automation system for factory logistics based on advanced Automatic Guided Vehicles using omnidirectional stereo surround perception.
- “Co-operative Mobility Services of the Future—CoMoSeF”, European Eureka project (2012–2015), aims to bring existing and emerging sensors, services and communication solutions closer to market, for implementing Intelligent Transportation Systems strategies and increase driving environment safety.
- “Cooperative Advanced Driving Assistance System Based on Smart Mobile Platforms and Road Side Units—SMARTCODRIVE”, Joint Applied Research Project (2012–2015), financed by the Romanian



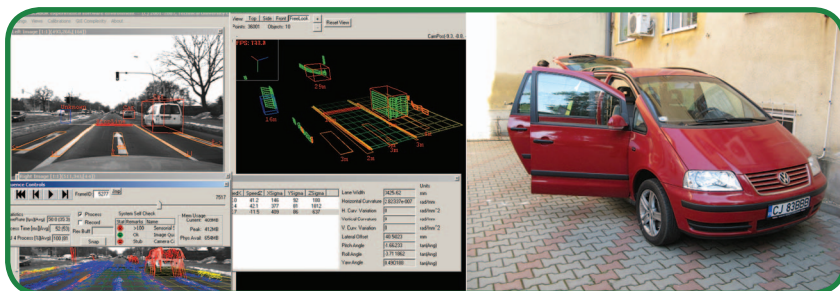
Environment modeling and perception as a dynamic elevation map.



Environment modeling and perception as a dynamic occupancy grid, and the dynamic oriented objects detected from the grid.



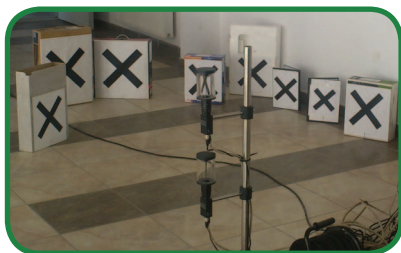
3D lane detection based on stereovision.



Driving environment perception.



Pioneer robot used for indoor environment perception and mapping.



Omnidirectional stereovision system, with a vertical baseline.

Authority for Scientific Research, aims to increase traffic safety and reduce fuel consumption using a cooperative approach based on the capabilities of the portable devices such as smartphones.

- “Automatic Medium and High Earth Orbit Observation System Based on Stereovision—AMHEOS,” Joint Applied Research Project (2012–2015), financed by the Romanian Authority for Scientific Research, aims to develop high accuracy automatic observation systems for medium to high Earth orbit objects detection and ranging.
- “Multi-scale multi-modal perception of dynamic 3D environments based on the fusion of dense stereo, dense optical flow and visual odometry information—MULTI-SENS, fundamental research project (2012–2015) funded by the

Romanian Authority for Scientific Research, aims to develop original models, original perception algorithms and original sensor fusion methods for accurate perception of the 3D environments for multiple robotic applications.

- “Road Environment Modeling” research project (since 2013) funded by Bosch aiming to develop accurate, robust and fast algorithms for stereovision based road environment modeling.

Accomplishments and Awards

The results of the group’s research activity are published in tens of journal articles (including articles published in *IEEE Transactions on Intelligent Transportation Systems* and *IEEE Intelligent Transportation Systems Magazine*), and hundreds of conference papers, including IEEE IV and IEEE ITSC, where the group has a constant yearly participation since 2004.

While the research results are often highly original and experimental, the focus of the group is always towards working systems. Most of the results are integrated into working prototypes, including a real-time stereovision system for driving environment perception, capable of onboard detection, tracking and classification of all relevant objects of the traffic scene.

As recognition of the IPPRRC research output and quality, as shown by the series of papers published in the field of sensory perception based



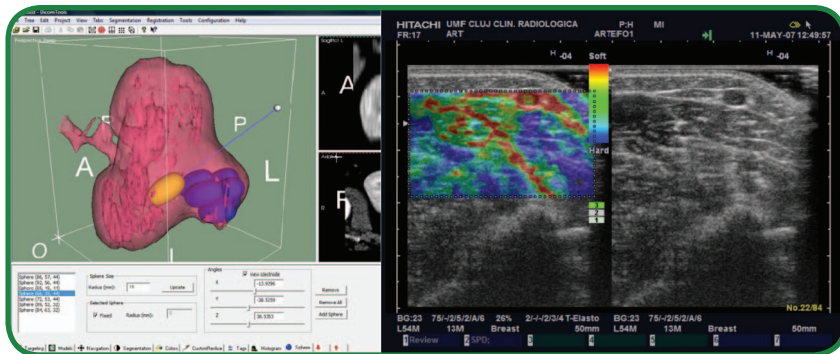
Prof. Sergiu Nedevschi

Prof. Sergiu Nedevschi received the M.S. (1975) and Ph.D. (1993) degrees in Electrical Engineering from the Technical University of Cluj-Napoca (TUCN), Cluj-Napoca. He was a researcher with the Research Institute for Computer Technologies, Cluj-Napoca from 1967–1983. In 1998 he was appointed as a Professor in Computer Science and founded the Image Processing and Pattern Recognition Research Laboratory at the TUCN. From 2000 to 2004, he was the Head of the Computer Science Department, TUCN, and from 2004 to 2012 the Dean of the Faculty of Automation and Computer Science. Since 2012 Prof. Nedevschi is Vice-President in charge with scientific research of TUCN.

His research interests include Image Processing, Pattern Recognition, Computer Vision, Intelligent Vehicles, Signal Processing, and Computer Architecture. Prof. Sergiu Nedevschi is an Associate Editor of the *IEEE Transactions on Intelligent Transportation Systems* (nominated Best Associated Editor in 2011). He is also the organizer of the IEEE Intelligent Computer Communication and Processing Conference (ICCP) and serves on several national and international committees.

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Medical image analysis for computer assisted diagnostic and prognosis.

on stereovision, Prof. Sergiu Nedevschi has been awarded the Romanian Academy's "Constantin Budeanu" Prize

in 2009, and in 2012 he was elected corresponding member of Romanian Academy of Technical Sciences.

Future Directions

The IPPRRC intends to continue and expand its research activity towards all fields related to image and other sensorial data processing and understanding, with applications in robotics, transportation, medicine, and astronomy. The team is constantly seeking opportunities for cooperation with national and international research institutions, Universities, and private companies, for applied and fundamental research ventures.

ITS

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