

C7 Image Processing, Image Analysis and Computer Vision

Time: Tuesday, 14.09.2010

Location: Humboldt-Building, Lecture Room 012

Chairman: T. Machleidt (DE-Ilmenau)

1:30 p.m.	J. Bosch, F. Klett (DE-Ilmenau)
<p>Safe Human-Robot Cooperation Based on 3D-Surveillance</p> <p>The increasing need of a closer cooperation between human and robots in industrial environments requires the appropriate handling of the danger situations that arise in the shared working spaces. The authors present a system which predicts and controls such situations, in order to ensure the safety of the workers while preserving the highest possible efficiency. The system is based on the fusion of the information from several sources, including stereo cameras used for monitoring the whole working space, and cameras used for controlling the specially dangerous areas (such as the surroundings of the gripper). The information from the stereo cameras is processed in order to build a 3D model of the scene, which is then used to compute the distance and relative velocity between the robot and humans. These data are stored and used to predict future hazardous situations, which are solved by appropriately reacting on the behaviour pattern of the robot. Additionally, the authors present a tool that serves to pre-select the most appropriate configuration of the system, according to the needs and characteristics of the use case to be applied. The amount and type of cameras, as well as their position and direction can be configured, and the degree of visibility of each of the regions in the working space is calculated, in terms of the number of cameras which can view them.</p>	
1:50 p.m.	D. Kapusi, P. Prinke, R. Jahn, K.-H. Franke, R. Nestler
<p>Geometric and Colorimetric Calibration For Multiview Camera Adjustments</p> <p>In modern computer vision, the sophisticated task of camera based object identification and tracking has a great application field, such as the autonomous observation of robot workspaces to deal safely with human interaction. Using multiple cameras increases redundancy, so robustness and allows achieving three-dimensional data of the objects of interest. Therefore, the camera parameters and their relative positions to each other have to be determined beforehand. To facilitate the correspondence-searching task from different points of view the optical sensors have to be calibrated to a unified color representation. In this article, a plane chessboard target with integrated color markers acts as the calibration reference for gathering the intrinsic and extrinsic camera parameters by means of subpixel accurate edge detection and the color transformation parameters at one go. The statistical uncertainty of the determined parameters decreases with the repeating of the calibration procedure at multiple target poses. The resulting calibration parameters enable the correction of lens distortions, the rectification of stereo images, the bundle adjustment and the color correction.</p>	

2:10 p.m. | H. Kantardshieffa (DE-Dresden)

Technology of 3D Data Transformation for Interactive Virtual Building Infrastructure Models

The development of an interactive virtual three-dimensional building infrastructure model implies a multi-level data transformation. The main focus of the proposed technology lies on three-dimensional data of the building form (carcass and development) as well as its infrastructure, which includes the inventory and the components of the technical building equipment such as heating, sanitary and electrical installations. The goal of the transformation is to provide different types of user-orientated final applications. The technology represents a pipeline where the 3D data is handled and transformed in a certain processing sequence. The 3D data is read in by different compatible systems and output in a transformed manner for further processing. Thus, an optimum efficiency is obtained regarding to the transfer and loading time of the final application. Each phase of the technology contains one of the main procedures such as generating, transforming and optimizing of 3D data. Transformation procedures are realised directly within the involved CAD systems such as Allplan, AutoCAD Architecture and AutoCAD MEP or implemented separately in C++ and CLisp. Raw data is imported from external systems. Several systems can be applied in each individual phase of the processing pipeline as well as skipped completely. Interfaces represent important key elements of the technology. The use of the interfaces DXF and IFC enables an efficient 3D data exchange between the various systems. Final applications with dynamic (VRML) and static (3D PDF) user interaction are supported. They are used for three-dimensional information and management purposes of building infrastructures.

2:30 p.m. | M. Schneider, D. Fey (DE-Erlangen)

Implementation of an Error-Robust Bucket-Method Algorithm for Elaboration of White Light Interferometry Data on GPGPUs

In industrial image processing the analysis of manufactured object surfaces is gaining more and more importance. One of the common and important scanning methods is the white light interferometry - height maps for an objects surface are obtained through object scanning with a white light beam. During the scan occurred interferences are taken by a camera and sent for analysis to a processing device. Depending on the captured interference pictures resolution and to be captured pictures count, requirements for memory space and computational power could be enormous. Thus, a preprocessing data amount reduction step is introduced. In this step for each pixel an approximation of the actually height is calculated and the so called range about center of interference is extracted. An efficient industrial manufacturing process requires delay-free surface analysis; therefore the preprocessing and the actual height computation step should be elaborated as fast as possible. Because the occurred interferences are independent for pixels of the same picture and the only dependence exists between correspondent pixels of successive pictures the complete processing step could be easily parallelized. Conventional multi-core processor systems are one possibility to gain a performance boost by partitioning the captured pictures and assigning the partitions to processor nodes. But parallel to the elaboration process of measurement data, some other external processes are also using resources on such systems. Therefore available memory and processing resources have to be shared between all running processes. Thus, the performance gain is reduced. Recently, GPGPUs have attracted the attention of HPC community and manufacturing industry as co-processors, because of their peak compute capability and high memory bandwidth, compared to conventional CPUs. With the advantage of having their own memory, the possibility of running many hundreds of threads parallel to another, GPGPUs are perfectly suited for massive-parallel applications like those in white light interferometry data analysis. In this article an efficient implementation of the error-robust five-bucket method for the white light interferometry data analysis preprocessing step, using nVidia's CUDA technology, is presented.

2:50 – 3:10 p.m. Coffee Break

3:10 p.m.	M. Mashi, Ch. Ament (DE-Ilmenau)
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Knowledge Based Systems for Pattern Recognition Allow Automated Process Stabilization in Laser Etching

Knowledge based systems for pattern recognition allow automated process stabilization in laser etching Authors: M. Mashi, C. Ament Abstract: Laser etching is a novel surface processing technique for metallic materials. Especially rigid materials as used for micro tools can be processed with this method. This process is controlled by several parameter, e.g. laser beam power, laser beam focus, material feed, flow of surrounding reactant, which depend on environmental conditions as temperature. Therefore, the process is very difficult to control, which hinders the introduction of this method into an industrial application. In our contribution a pattern recognition approach is presented, which helps stabilizing process quality: For process calibration a material probe with a number of grooves with fixed sets of parameters is produced. Then, the probe surface is optically measured and the obtained data is provided to the algorithm. It is able to localize the grooves automatically. For this purpose, two methods of machine learning are deployed. First is nearest neighbour method, second is clustering. Due to noise it is difficult to decide which a groove is and which is not. A knowledge based system is used for this decision. The algorithm allows adaptive behaviour to different probe topologies. After groove recognition, the depth and width of the groove is identified. These parameters can be provided to the automated machine calibration.

3:30 p.m.	M. Blau, G. Linß, M. Rosenberger, M. Schellhorn, A. Göpfert (DE-Ilmenau)
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Resource-Friendly Configuration Interface for Image Sensors on Field Programmable Gate Arrays

The usage of field-programmable gate arrays (FPGA) for real-time processing of image data fitted to the image sensor relieves the indicating computer system significantly. E.g. filter operations or specific image manipulation can be realized in the camera unit itself. The biggest effort of this system is the possibility of parallel data handling of partial calculations inside the FPGA. In order to be able to change filter parameters or to enable or disable filters very fast it is useful to control the FPGA via an internal interface. So a complex reconfiguration of the FPGA is no longer necessary. To transmit appropriate control-commands to the FPGA a control bus is needed. An inter-integrated circuit bus (I²C-Bus) would be particularly good because of its simple construction and the fact that it is already included in most image sensors. By using a new intellectual property core (IP-core), which includes the function of the I²C-Slave-Controller, it is possible to provide an adequate and reliable bus-controller. The I²C-Slave-Controller is executable by itself and does not require a soft-core processor. Received data and data to be sent is stored in a register which is variable in length (depending on its usage). Thereby the integration in existing VHDL-projects is easier. The controller has the ability to restart itself in case of error, so a high level of reliability is assured.

End of Lecture Session	
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