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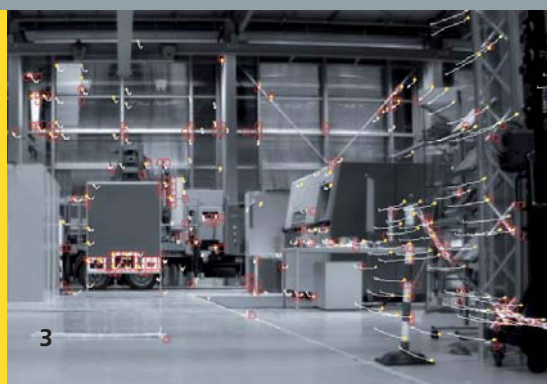

1 *Mobile robot with visual navigation.*
Photo: Sven Kutzner
2 *Flexible camera positioning.*
Photo: Sven Kutzner
3 *Drive-by camera self-calibration.*
Photo: Christoph Walter

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VISUAL POSITION SENSING AND NAVIGATION FOR MOBILE ROBOTS

Overview

Continuous localization of mobile units and computer controlled navigation that builds upon this, e.g. automatic guided transport systems, have become a basic technology in automation and logistics. At the same time, most existing localization systems require the installation of components such as reflectors, conductor loops, etc. in the work area and/or the use of expensive sensors such as laser scanners on board mobile systems.

Fields of Application

By contrast, visual localization based on digital camera systems without the need for artificial landmarks provides significant potential to reduce the costs of such systems. This is putting interesting new fields of application such as transport or mobile assistance systems for labs, offices or even residential settings within reach. The technology is particularly interesting since it furnishes great potential for many and diverse applications at manageable costs.

Technologies and Options

The core technologies include:
- visual odometry and incremental tracking of changes in position by observing fixed points in the environment
- simultaneous visual localization and mapping with distinctive orientation points already present in the environment (landmarks) to navigate precisely

Available options include:
- integration with common sensor systems; e.g. wheel odometry, inertial measurement systems, etc.
- integration of infrared illumination solu-

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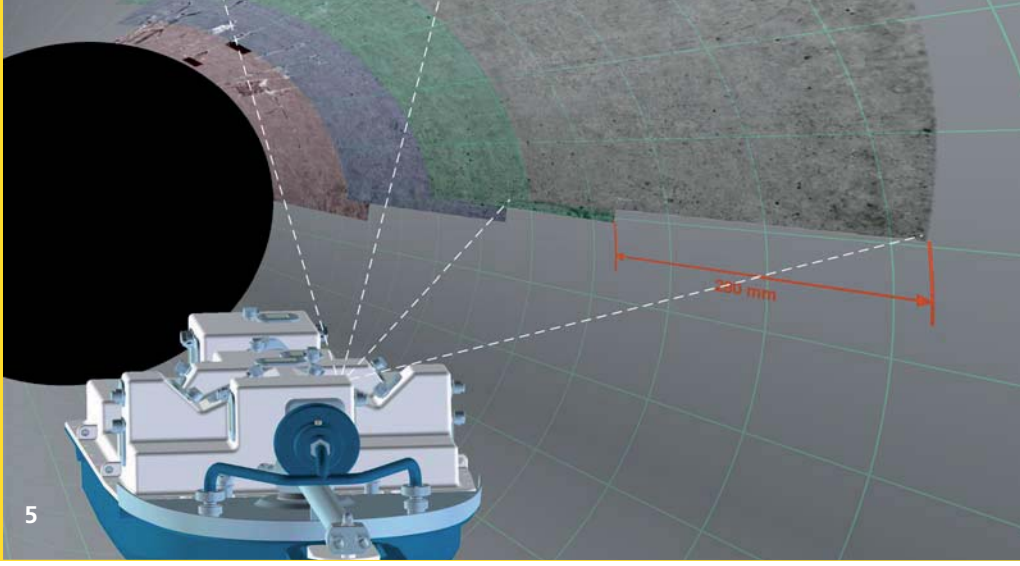

tions for use in poor ambient light
– integration of selectively implemented artificial landmarks to enhance localization performance
– modifications for specific cases of application

Special Solutions for Special Environments

Specific applications or client requirements may necessitate special solutions. We are able to flexibly modify the methods of visual position scanning, e.g. to incorporate the particular attributes of orientation points.
For instance, in a project contracted by the Emschergenossenschaft, we developed a special system that visually scans and tracks a floating sewer system inspection robot's position. Usable in concrete pipes with diameters of 1.4 m to 2.8 m, the system determines the robot's forward movement extremely precisely. In addition, this special system enables the robot to reliably relocate any position with a tolerance of less than 2 mm.

Portions of this work were completed in the project Applied Virtual Technologies Focused Long-range on the Product and Production Equipment Life Cycle AVILUSplus, which is closely related to the AVILUS Technology Network, a consortium of business and research partners that is developing efficient technologies in the context of virtual and augmented reality.

The joint project AVILUSplus is being supported by the Federal Ministry of Education and Research as part of its ICT 2020 program.

GEFÖRDERT VOM

Bundesministerium
für Bildung
und Forschung

For more information on the joint project, visit www.avilusplus.de.

For more information on this topic, visit www.rs.iff.fraunhofer.de.

4 *Option: Additional infrared reflecting landmarks. Photo: Sven Kutzner*
5 *Special solution: Visual inspection robot localization in concrete pipes.*