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Localization of an Automated Guided Vehicle (AGV) by Stereo Based Visual Odometry and Artificial Landmark Detection

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Abstract

Localization in a known environment is an essential topic in the field of robotics – consequently a variety of methods (e.g. Visual Odometry or SLAM) are scientifically well established. Compared to experimental robotics, the determination of position based on Machine Vision approaches is not yet fully implemented in the domain of Automated Guided Vehicles (AGV). Thus, the aim of this master's thesis is to design, realize and test a localization system exclusively based on Machine Vision for the use in AGVs. The x- and y-axis positioning as well as the determination of orientation of the vehicle in all three axes is carried out by a stereo camera based Visual Odometry approach and a supporting detection of artificial landmarks placed on the ceiling. Both methods complement each other perfectly: while Visual Odometry bridges distances without landmarks, drift caused by Visual Odometry is corrected by artificial landmarks. Test series have shown that the localization error falls below ±20mm if the distance between camera and landmark does not exceed 4500mm. Also the inclination of the vehicle is equalized. This localization system has various advantages compared to well established methods: designing and installation efforts can be reduced, while the flexibility for route changes can be increased compared to traditional magnetic guidance systems. The interference immunity is higher compared to contour matching methods due to the use of absolute reference points placed on the ceiling. The proposed system is not suitable for use in halls because the distance between camera and ceiling-landmarks should not exceed 4500mm. Nevertheless, this localization system is an interesting alternative to well established methods primarily for the use in the public sector, e.g. hospitals or libraries.