Camera Placement Optimization in Object Localization Systems

Dávid Szalóki

This paper discusses the placement of cameras in order to achieve the highest possible localization accuracy. It is reached by using several cameras with redundant fields of views. A camera model is introduced and the components which cause the localization errors are identified. The localization accuracy measure is defined for one and for multiple cameras too. The problem of adding a new camera to the system in order to improve the accuracy is formulated. The method for finding the optimal placement of this new camera is presented. Some features are applied for getting an advanced method for optimizing the placement of multiple cameras. In this area two optimization algorithms are introduced and examined.

Assume that we have a camera system containing fixed and movable cameras. We would like to track an object in the world as accurately as possible. The movable cameras can be placed by the system optimally so that the localization accuracy gets it's highest possible value. The position and orientation constraints of the movable cameras are the limitations. We would like to suggest a method for placing the movable cameras in order to get the highest possible localization accuracy. The localization accuracy is defined as the largest eigenvalue of the inverse of the resulting covariance matrix.

At first a camera model has to be formulated. The components which cause the localization inaccuracy can be identified. The localization accuracy has to be defined and a measure has to be chosen. The nature of these has to be examined for better understanding their behavior. As a first step they can be formulated in 2D for one observed point. Later this model can be generalized into 3D and for an observed area or volume instead of one observed point. The optimal placement of one camera can be formulated. The optimization of multiple cameras together can be deduced from this one camera case. Finally, two algorithms are formulated and examined.

Acknowledgements

This work was partially supported by the European Union and the European Social Fund through project FuturICT.hu (grant no.: TAMOP-4.2.2.C-11/1/KONV-2012-0013) organized by VIKING Zrt. Balatonfüred.

This work was partially supported by the Hungarian Government, managed by the National Development Agency, and financed by the Research and Technology Innovation Fund (grant no.: KMR_12-1-2012-0441).

References

[1] Dávid Szalóki and Norbert Koszó and Kristóf Csorba and Gábor Tevesz, Marker localization with a multi-camera system, 2013 IEEE International Conference on System Science and Engineering (ICSSE)

[2] Kristóf Csorba and Dávid Szalóki and Norbert Koszó, Towards a Visual Sensor Network Built from Smartphones, 3rd Eastern European Regional Conference on the Engineering of Computer Based Systems (ECBS-EERC)

[3] Dávid Szalóki and Norbert Koszó and Kristóf Csorba and Gábor Tevesz, Optimizing Camera placement for localization Accuracy, 14th IEEE International Symposium on Computational Intelligence and Informatics (CINTI)