

Marker-Based Localisation System Using an Active PTZ Camera and CNN-Based Ellipse Detection

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Abstract

Localisation in GPS-denied environments is challenging and many existing solutions have infrastructural and on-site calibration requirements. This paper tackles these challenges by proposing a localisation system that is infrastructure-free and does not require on-site calibration, using a single active PTZ camera to detect, track and localise a circular LED marker. We propose to use a CNN trained using only synthetic images to detect the LED marker as an ellipse and show that our approach is more robust than using traditional ellipse detection without requiring tuning of parameters for feature extraction. We also propose to leverage the predicted elliptical angle as a measure of uncertainty of the CNN's predictions and show how it can be used in a filter to improve marker range estimation and 3D localisation. We evaluate our system's performance through localisation of a UAV in real-world flight experiments and show that it can outperform alternative methods for localisation in GPS-denied environments. We also demonstrate our system's performance in indoor and outdoor environments.