BRISK-Based Visual Feature Extraction for Resource Constrained Robots

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Abstract. We address the problem of devising vision-based feature extraction for the purpose of localisation on resource constrained robots that nonetheless require reasonably agile visual processing. We present improvements with a state-of-the-art Feature Extraction Algorithm (FEA) called Binary Robust Invariant Scalable Keypoints (BRISK) [8]. A key aspect of our contribution is the combined use of BRISK0 and U-BRISK as the FEA detector-descriptor pair for the purpose of localisation. We present a novel scoring function to find optimal parameters for this FEA. Also, we present two novel geometric matching constraints that serve to remove invalid interest point matches, which is key to keeping computations tractable. This work is evaluated using images captured on the Nao humanoid robot. In experiments, we show that the proposed procedure outperforms a previously implemented state-of-the-art vision-based FEA called 1D SURF (developed by the rUNSWift RoboCup SPL team), on the basis of accuracy and generalisation performance. Our experiments include data from indoor and outdoor environments, including a comparison to datasets such as based on Google Streetview.

Keywords: BRISK, BRISK0 - U-BRISK, feature extraction, localisation, resource constrained robot, Nao

1 Introduction

The emergence of field robots that must persistently operate in dynamic environments brings with it the need for localisation based on features that may not have been explicitly engineered with the robot in mind. The issue is particularly problematic for resource constrained robots that must adopt a lower complexity approach to computation. Generally robust localisation needs rich features such as is available from Feature Extraction Algorithms (FEAs) which form a crucial part of vision systems. FEAs are utilised in vision systems in order to detect *landmarks* (also known as *interest points*) and match them between corresponding images. FEAs can therefore be used for tasks such as localisation and are commonly used in systems such as automated-driving and underwater exploration [4,13]. Scale Invariant Feature Transform (SIFT) and Speeded-Up Robust Features (SURF) are examples of FEAs that can be used for this task [1,3]. However, these algorithms have significant processing requirements and therefore are not applicable to a wide variety of resource-constrained systems.