Person following by mobile robots: analysis of visual and range tracking methods and technologies

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Abstract. Person following by mobile robots in unconstrained environments has not been yet successfully solved, and new approaches to tackle this problem need to be developed. The main goal of this article is to analyze the use of state-of-the-art computer vision methods for human detection and tracking when a robot is trying to follow a person. The methods were selected taking into account their accuracy in previous studies as well as being real-time or near real-time. Thus, *tracking based on a HOG person detector*, *tracking-by-detection with Kernels* and *compressive tracking* were analyzed and compared to methods based on the use of Kinect and laser sensors using a database built specifically for this purpose. The database was captured using a service robot, and it considers real-world conditions. The results show that the vision-based methods are much more robust for tracking purposes than standard range-based methods used by the robotics community, although being slower.

Keywords: Person following, RoboCup, depth image, laser, benchmark

1 Introduction

The detection and tracking of humans by robots are key abilities of service and social robots. These basic abilities are required to implement several applications, among them person following. If robots will be part of our daily life in a near future, then they need to be able to follow us, as well as to walk with us and navigate among us, in daily life environments. However, person following by mobile robots in unconstrained environments has not been yet successfully solved. For instance, in the 2012 RoboCup@Home competition[1], 14 of 17 service robots were not able to follow a human in the "Follow Me" test, competition which was ran in an indoor setup under dynamic conditions (non-controlled illumination, audience near the robots, etc.) [6][7][8].

In the RoboCup@Home community most of the research teams address the person following problem by using active infrared-based depth sensors such as the Kinect and lasers. But, as it will be shown in this article, the use of this kind of sensors is not always reliable, because their sensing capabilities depend on the reflecting material (e.g. in many cases black materials do not reflect enough infrared light), and on the

[1] Robocup@Home competition website: http://www.robocupathome.org/
[2] OpenNI: http://www.openni.org/