Distinguish Competitor Robot Swarms with On-board Visual Perception System

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A robot swarm consists of a number of physical robots, where each robot as autonomous system works together, communicates with other team members. One of the major tasks in a robot swarm is the team member detection in various environments meanwhile doing its tasks and sharing information with other swarm members. A possible solution to this problem is provided now. Our kin recognition system is based on that the members of the swarm have an on-board visual perception system and each robot is masqueraded with a movement invariant zebra pattern. The visual kin recognition method [1] employs Fourier analysis of this zebra pattern which has got a reliable working in various environment. The Fourier transform is able to emphasize the features of zebra pattern and provides a good solution to pattern recognition. For the sake of simplicity we used the fast adaptation of Fourier transform. This method executes feature enhancement and feature selection on one captured image in complexity of $c{\cdot}n{\cdot}\log n$, where $n{\cdot}\log n$ is the complexity of the fast Fourier transform and c is the column sampling constant. A much more complex problem is when more competitor robot swarms are in the same environment. In this case kin recognition [1] is completed with a competitor robot recognition, too. In this abstract we assume that two competitor robot swarms are working in the same environment and the robots of the two swarms know about distinguishing marks of the other swarm. Distinguishing marks in this scope means two different zebra patterns, which have an effect on the different Fourier spectrum results. To distinguish competitor robot swarms and to resolve the problem two different feature selection functions are needed. These functions are actually threshold functions, which select the columns of pattern from the digital image and can identify the robot swarm objects. The threshold functions are determined empirically. These functions uniquely determine the swarm of a certain robot and distunguish it from the objects of the environment. Another scope of this method is the distance evaluation from the detected frequency. The byproduct of detection is a frequency value which grows along with the awaying zebra pattern. With the help of this method the robot-robot distances could be determined by the detected frequencies. Since the two different robot swarms generate different frequencies two distance measurements are needed for the distance evaluation. The result of the measurements shows a linear relationship between frequency and distance values thus the results can be approximated well by two linear functions. This method also provides a useful tool to distinguish competitor robot swarms including a distance evaluation feature.

References

[1] K. Bolla, T. Kovács, G. Fazekas. Compact Image Processing-based Kin Recognition, Distance Measurement and Identification Method in a Robot Swarm, *ICCC-CONTI 2010 Conference*, submitted.