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論文 / 著書情報
Article / Book Information

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Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

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（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	知能システム科学　専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of　（　工学　）
学生氏名： Student's Name	木村　大毅	指導教員（主）： Academic Advisor(main)	長谷川　修
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

This study proposed knowledge transfer methods for intelligent robots. This thesis is organized in five chapters as follows:

Chapter 1: Introduction

In the near future, there will be a shortage of labor due to the aging population. To compensate for this shortage of personnel, developing autonomous mental development robots is seen as a solution to this problem. However, it's impossible for a robot to learn all human knowledge such as object categories and place information. Also, when robots distribute among the population, these have to be individually taught knowledge based on its unique specifications. It's also impossible to teach all kinds of robots in such future. Therefore in this thesis, we propose novel methods to transfer to itself for acquiring a large variety knowledge within a short period of time, and also transfer learned knowledge to other robots.

Chapter 2: Self-transfer using visual information

Firstly, we focused on transferring knowledge to itself. We proposed a novel attribute-based fast online learning and transfer method by using a new proposed statistical recognition method on self-organizing and incremental neural network, called STAR-SOINN. This neural network is extended from SOINN to do statistical supervised learning; it can also memorize multiple concepts and classes with only one network. We conducted experiments using the proposed attribute-based transfer method and competitive methods to estimate attributes of an unknown animal by visual information. For example, the method has to estimate "has tail", "cannot fly", and "walks slowly" attributes from a photo of a 'pig' without knowledge of pigs; it needs to transfer knowledge acquired from previously seen animals. According to these experimental results, the recognition rate of the proposed method is equivalent to the previous online method. Also, there are numerous advantages of the proposed method compared to other methods: the number of required neural networks is minute; processing times for learning and testing are shorter; it has the ability to use noisy Internet data; it can define real-valued attributes.

Chapter 3: Self-transfer using multimodal information

During the next phase, we focused on using attribute learning for real robots. If a robot is expected to perform in the real world, the robot needs to recognize many unknown objects by using some multimodal sensors such as a microphone, a laser sensor, and a touch sensor. Therefore we proposed an attribute-based learning and transfer method for multimodal sensors. This method uses STAR-SOINN, and has an integration method for attribute values from some modalities. By using this method, the robot can guess attributes of "paper-made" and "soft" before grasping a paper cup even if it's the robot's first time to touch the cup. Then the robot will grasp this paper cup softly. Next we compared proposed method to previous methods by two experiments to check the object recognition accuracy and to try estimating attributes of unknown objects. For the recognition task, the proposed method is more accurate and the processing time is quicker than a method that naively integrates the modalities, and also a previous method. In the estimation of attributes task, proposed method could estimate almost all attributes for unknown objects.

Chapter 4: Transferring between robots using motion knowledge

Finally we focused on a method to transfer knowledge to another robot with different specifications. If there are two robots with different arm lengths, the end-effectors of these robots with same joint angles are different. Therefore, it is difficult to share knowledge with other robots without an adaptation for specifications. We proposed a method that can adapt the motion information by using an end-effector position errors that are obtained during trials by a little bit motion information. This method is improved from an update algorithm of the Self-Organizing Map (SOM). To test this method, we conducted experiments for quantitatively evaluation using robots in a simulator and a real robot. For instance, if one robot was taught about how to reach for a ball, the robot can share this motion skill to another robot, then the other robot can also reach. According to these experiments, a real robot can adapt and use transferred motion knowledge from the robot in the simulator.

Chapter 5: Conclusion

In this paper, we focused on a knowledge transfer method for intelligent robots. The first and second methods are based on SOINN, which was originally adapted from SOM. The third method is based on the update algorithm of SOM. Therefore, these methods use a similar algorithm and have the same network structure. In other words, these methods can be combined into one method that is a method to transfer knowledge to itself and also to other robots. This means if the robot learns an object's vital information, it can use this knowledge while it learns another object and recognize the unknown object. Also this robot can distribute knowledge to other robots. We believe these methods will be become an important baseline technology for real world robots in the future.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

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