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| 学位論文の題目 Title of Thesis | 6DOF Stereo Visual Servoing by Photo-Model-Based Pose Estimation (写真モデルを用いたポーズ推定による6自由度ステレオビジュアルサーボ) |
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| 学位論文内容の要旨 | |
| <p>A robot control technology using visual information in the feedback loop, which is named as visual servoing, is expected to be able to allow the robot to adapt to changing or unknown environments. However, it is difficult to accurately detect the 3D pose (position and orientation) of an object. A model-based method is a way used to realize the visual servoing. Although it enables a monocular vision to detect the target object's distance, its accuracy is not enough. Many studies have used RGB-D camera, composed of one RGB camera and depth sensor with infrared light, to improve the distance detection capabilities of monocular vision. However, it cannot avoid the disadvantage that its depth distance measurement is inaccurate. Unlike the RGB-D method, stereo vision is another possible approach to estimate 3D pose.</p> <p>The author has proposed a stereo vision visual servoing system that uses a 3D model for the target's pose detection. The adoption of the 3D model to estimate the target's pose enables to improve the 3D pose estimation accuracy. However, the process of constructing the 3D model in programming was complicated. In order to overcome the disadvantages encountered in constructing 3D models, photo-model-based pose estimation method has been developed for picking and placing clothes. It simplified the model making process where this process does not need to predefine the object's size, shape, color, pattern, and design in the programming language. And more importantly, it can deal with deformable goods.</p> <p>This thesis proposes a real-time 6DOF photo-model-based pose estimation method used for 6DOF visual servoing purposes. This method can detect the full pose of a 3D target object. To the best of the author's knowledge, no studies have yet been conducted on 3D pose visual servoing with only 2D photo of an object in the real world. What the author wants to discuss in this paper is whether a 2D photo-model generated from one photo of a 3D target can estimate the full 6DOF pose of the target and whether the estimated pose can be used for 3D pose visual servoing. And the results have shown that the full pose of an arbitrary 3D target can be estimated in real-time by using only a 2D photo and it also enables 3D visual servoing to the target. The above results have been confirmed by real experiments that use a 6DOF manipulator with stereo vision at the end-effector.</p> | |

論文審査結果の要旨

A robot control technology using visual information in the feedback loop, which is named as visual servoing, is expected to be able to allow the robot to adapt to changing or unknown environments. However, it is difficult to accurately detect the 3D pose (position and orientation) of an object. A model-based method is a way used to realize the visual servoing. Although it enables a monocular vision to detect the target object's distance, its accuracy is not enough. Stereo vision is another possible approach to estimate 3D pose.

The author has proposed a stereo vision visual servoing system that uses a 3D model for the target's pose detection. The adoption of the 3D model to estimate the target's pose enables to improve the 3D pose estimation accuracy. However, the process of constructing the 3D model in programming was complicated. In order to overcome the disadvantages encountered in constructing 3D models, photo-model-based pose estimation method has been developed for picking and placing clothes. It simplified the model making process where this process does not need to predefine the object's size, shape, color, pattern, and design in the programming language. And more importantly, it can deal with deformable goods.

This thesis proposes a real-time 6DOF photo-model-based pose estimation method used for 6DOF visual servoing purposes. This method can detect the full pose of a 3D target object. To the best of the author's knowledge, no studies have yet been conducted on 3D pose visual servoing with only 2D photo of an object in the real world. What the author wants to discuss in this paper is whether a 2D photo-model generated from one photo of a 3D target can estimate the full 6DOF pose of the target and whether the estimated pose can be used for 3D pose visual servoing. And the results have shown that the full pose of an arbitrary 3D target can be estimated in real-time by using only a 2D photo and it also enables 3D visual servoing to the target. The above results have been confirmed by real experiments that use a 6DOF manipulator with stereo vision at the end-effector.

It has been judged that the applicant satisfies the qualification condition for doctor degree in Engineering of the Graduate School of Natural Science and Technology at Okayama University.