International Journal of Advancement in Technology

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Editorial

Robotics Visual Servoing System Technology: Editorial

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ABSTRACT

Major difficulties and challenges of modern robotics systems are around how to give robots the ability to learn and make decisions for themselves. The visual servoing control approach is a common robotic system strategy for perceiving the environment through vision. New robotic systems can be guided by the vision to execute more sophisticated tasks in more complex working contexts. This survey attempts to describe current learning-based algorithms, particularly those that combine with Model Predictive Control (MPC) in visual servoing systems, as well as provide some pioneering and advanced references with numerical simulations. The impact of classical control tactics on robotic visual servoing systems is discussed, as well as generic modeling methods for visual servoing. The benefits of incorporating neural network- and reinforcement-learning-based algorithms into systems are explored. Finally, the future directions of robotic visual servoing systems are summarised and forecasted based on existing research progress and references.

INTRODUCTION

Robots are now required to do more sophisticated activities, such as medical treatment and marine equipment, as a result of the rapid advancement of robotics. Ultrasonic, laser, gyroscope, and other sensors are extensively employed in robotic systems. However, if these traditional sensors are the sole tools used to guide the robot through these tasks, performance may suffer or the task would fail because traditional measurements can only acquire insufficient data and are only suitable for structured and unchangeable settings. The vision sensor is a low-cost, non-contact sensor that can measure object distance, color, and other attributes. Visual information's diversity and readability have steadily become an essential component of robotic systems. Various computer vision algorithms are presented, which provide robotics specialists with a key tool for making full use of vision sensors. On the other hand, the pioneers Hutchinson and Chaumette have produced three instructional studies of visual servoing systems which have inspired many researchers to focus further on an in-depth study on robotic visual servoing systems. Intelligence has become an important attribute of visual servoing systems in recent years, as it can help robots execute more complex tasks in unstructured situations. To our knowledge, however, just a few surveys suggest that learning-based control in visual servoing systems is effective. The existing gap is most evident in the dearth of survey papers that highlight applications of the most recent learning-based methods in visual servoing systems, as well as the differences and relationships between these methods and classic control methods. Our survey aims to solve the above-mentioned gap by providing relevant references and analyses in the field of learning-based visual servoing systems. This survey compiles a comprehensive list of traditional and learning-based control methods utilized in visual servoing systems. Readers can easily comprehend the research development of learning-based visual servoing systems from three perspectives by reading this survey: 1) Controller design; 2) Model learning; and 3) Optimization problem-solving. They can also learn about specific techniques to deal with difficulties like unknown depth information, parametric uncertainty, nonlinear optimization, self-decision, and so on, based on the survey's analysis and references. The advantages and disadvantages of traditional and learning-based control in visual servoing systems are also examined in this survey. By conducting this survey, we will be able to present interdisciplinary ideas to scholars and urge them to integrate the benefits of classical control methods with learning-based methods to balance the safety and intelligence concerns of robotic visual servoing systems.

CONCLUSION

Learning-based algorithms for robotic visual servoing systems have been thoroughly explored in this study. The first uses neural networks, whereas the second use (deep) reinforcement learning. In terms of unknown depth, uncertain dynamics, difficulties in limited optimization, and interaction with environments, state-of-the-art algorithms have had a lot of success in solving the challenges of the robotic visual servo. In conclusion, many classifications apply to various instances.

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Received: November 04, 2021; **Accepted:** November 11, 2021; **Published:** November 25, 2021

Citation: Williams S. (2021) Robotics Visual Servoing System Technology: Editorial. Int J Adv Technol. 12:123.