摘要

多旋翼飞行器因其体积小、重量轻、造价低，具有好的机动性能和操纵性能而才成为一种被广泛使用的现代工具，在搜索、航拍、监视等领域表现出出色的特征优势，更被应用到军事行动等特殊领域。现代战争中已经开始将多旋翼投入到狭窄空间和街头楼巷的作战任务中，但是通常需要经验丰富的操纵手控制其对目标实现精确打击，这种方法有高危险性、低易用性等弊端，所以本文希望提出一种可靠的基于图像的伺服控制方法，使多旋翼能够在近距离自主飞行打击目标。

本文主要工作如下：

首先建立多旋翼通道模型和视觉伺服模型，作为后续算法设计的数学基础；其次通过实验综合比较多种成熟的在线追踪算法的性能，并选用表现最出色的KCF完成图像追踪环节；第三是核心章节——设计基于视觉的追踪打击控制算法，通过解耦雅阁比矩阵将视觉伺服模型简化成纵向和横侧向通道模型，分别设计两个通道中的控制算法并证明算法的收敛性；最后基于设计环节，在MATLAB上利用虚拟现实工具箱对视觉伺服算法进行视景仿真验证，并分析仿真结果。

在实验环节，本文采用控制变量法，完成多组目标不同运动轨迹、不同运动速度的视景仿真，仿真结果分析表明，本文的设计方法可以实现多旋翼飞行器基于图像的近距离追踪打击控制，并探讨了目标不同运动轨迹、不同运动速度对控制效果的影响。

关键词：多旋翼飞行器，视觉伺服控制，图像追踪，精确打击

The multicopters have become widely used modern tools, due to their small size, light weight, low cost, good maneuverability, and stability, showing excellent features in the fields of search, aerial photography, surveillance, etc. The multicopters are also applied to special areas such as military operations. In modern warfare, multicopters have been put into the battle missions of narrow spaces and street buildings, but the tasks usually require experienced remote pilots to make precision attacks, which has many disadvantages such as high risk and low ease of use, etc. This dissertation aims to propose a reliable image-based servo control algorithm so that multicopters are able to autonomously make precision attacks.

The main work of this dissertation is shown as follows:

Firstly, the multicopter channel model and the visual servo model are established for the following algorithm design. Secondly, comparing the performance of various mature online visual tracking algorithms comprehensively, the Kernelized Correlation Filter (KCF) is selected. The third part, a key part of this dissertation, is about image-based servo control algorithm. The visual servo model is simplified as a longitudinal and a horizontal channel model with the interaction matrix decoupled. Then, the control algorithms for the two channels are designed, and the convergence is further proved. Finally, based on the design link, the dissertation uses virtual reality toolbox on MATLAB to verify the visual servo algorithm by visual simulation and the results are analyzed.

In the simulation process, by adjusting the control parameters, multiple groups of visual simulations are performed, where different target trajectories and velocities are considered. The simulation results show that the design method can realize the image-based precision attacks based on multicopters. The control performance of different target trajectories and velocities are discussed.

Keywords: multicopters, visual servo control, visual tracking, precision attack