

Research and Development of Unmanned Aerial Vehicle Helicopter Systems

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Abstract

In recent years, research and development of unmanned vehicles has gained much attention in the academic and military communities worldwide. Objects like unmanned aircraft, underwater exploiters, satellites and intelligent robotics are widely investigated as they have potential applications in both military and civil domains. They are developed to be capable of working autonomously without human pilot. Challenge is that they need to deal with various situations arisen in much complicated and uncertain environment, such as unexpected obstacles, enemies attacking and device failures. Besides, they are required to communicate with technical personnel in the ground station. Consideration on a wide range of factors needs to be taken. Control systems for the unmanned vehicles are required to integrate not only basic input-output control laws, but also high-level functionalities for decision making and task scheduling. Software systems for unmanned vehicles are required to perform tasks from hardware driving to the management of device operation, and from traditional input-output control law implementation to task scheduling and event disposal.

In this talk, we aim to explore the research and development of a full functional UAV (unmanned aerial vehicle) helicopter system, which consists of a small-scale basic helicopter with all necessary accessories onboard and a ground station. The UAV helicopter system is an integration of advanced technologies developed in communications, computing and control areas. It is an excellent test bed for testing and implementing modern control techniques. It is a very challenging process. The aerodynamics of small-scale helicopter is similar to its full-scale counterpart but owns some unique characteristics such as the utilization of stabilizer bar and higher main/tail rotor's rotation speed. Besides these, the strict limitation on payload also increases the difficulty on upgrading a small scale helicopter to a UAV with full capacities. Based on its various characteristics and limitations, a light-weight but effective onboard computer system with corresponding onboard/ground software should be carefully designed to realize the system identification and automatic flight requirements. These issues will be addressed in detail in the talk. Research on utilizing the system for accomplishing ground target tracking and attacking, flight formation, and future research directions on the development of urban and indoor navigation systems as well as precision landing systems on moving platforms will be highlighted.



Ben M. Chen received his B.S. degree in mathematics and computer science from Xiamen University, Xiamen, China, in 1983, M.S. degree in electrical engineering from Gonzaga University, Spokane, Washington, USA, in 1988, and Ph.D. degree in electrical & computer engineering from Washington State University, Pullman, Washington, USA, in 1991. He was a software engineer in South-China Computer Corporation, Guangzhou, China, from 1983 to 1986, and was an assistant professor from 1992 to 1993 in Department of Electrical

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He is the author/co-author of over 200 research articles in international journals and conference proceedings, and 7 research monographs including *Robust and H_∞ Control* (New York: Springer, 2000); *Hard Disk Drive Servo Systems* (New York: Springer, 1st edition, 2002; 2nd edition, 2006); *Linear Systems Theory: A Structural Decomposition Approach* (Boston: Birkhauser, 2004; Chinese Translation Published by Tsinghua University Press, 2008). He held associate editor appointments with IEEE Transactions on Automatic Control (1999-2001), and Asian Journal of Control (2002), Control and Intelligent Systems (2002–2007) and Automatica (2005–2008). He currently serves as a member of international advisory board of Kuwait Journal of Science & Engineering (2003–), holds associate editor appointments with Systems & Control Letters (2004–), Journal of Control Science and Engineering (2006–), Transactions of the Institute of Measurement and Control (2007–), and serves as an editor-at-large for Journal of Control Theory and Applications (2008–).

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