Computer Vision Techniques for Rotorcraft Low Altitude Flight

Banavar Sridhar

NASA Ames Research Center

Rotorcraft operating in high-threat environments fly close to the Earth's surface to utilize surrounding terrain, vegetation, or manmade objects to minimize the risk of being detected by an enemy. Increasing levels of concealment are achieved by adopting different tactics during low-altitude flight. Rotorcraft employ three tactics during low-altitude flight: low-level, contour, and nap-of-the-Earth (NOE). The key feature distinguishing the NOE mode from the other two modes is that the whole rotorcraft, including the main rotor, is below tree-top whenever possible. This leads to the use of lateral maneuvers for avoiding obstacles, which in fact constitutes the means for concealment. The piloting of the rotorcraft is at best a very demanding task and the pilot will need help from onboard automation tools in order to devote more time to mission-related activities. The development of an automation tool which has the potential to detect obstacles in the rotorcraft flight path, warn the crew, and interact with the guidance system to avoid detected obstacles, presents challenging problems.

This presentation describes research which applies techniques from computer vision to automation of rotorcraft navigation. The effort emphasizes the development of a methodology for detecting the ranges to obstacles in the region of interest based on the maximum utilization of passive sensors. The range map derived from the obstacle-detection approach can be used as obstacle data for the obstacle avoidance in an automatic guidance system and as advisory display to the pilot. The lack of suitable flight imagery data presents a problem in the verification of concepts for obstacle detection. This problem is being addressed by the development of an adequate flight database and by preprocessing of currently available flight imagery. The presentation concludes with some comments on future work and how research in this area relates to the guidance of other autonomous vehicles. For further details on the work reported here please refer to the following list of papers.

References

1) V. H. L. Cheng and B. Sridhar, Automated Nap-Of-The-Earth Flight, 1988 American Control Conference, Atlanta, GA, June 15-17, 1988.

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3) R. V. Denton, N. J. Pekelsma and F. W. Smith, Autonomous Flight and Remote Site Landing Guidance Research for Helicopters, TAU Corporation Final Report on NASA Contract NAS 2-12180, Aug. 1987.

4) B. Sridhar, V. H. L. Cheng and A. V. Phatak, Kalman Filter Based Range Estimation for Autonomous Navigation Using Imaging Sensors, 11th IFAC Symposium on Automatic Control in Aerospace, Tsukuba, Japan, July 1989.

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