

Practical Aspects of Range Determination and Tracking of Small Drones by Their Video Observation

Igor Koryttsev

Kharkiv National University of Radio Electronics
Kharkiv, Ukraine

Sergiy Sheiko

Kharkiv National University of Radio Electronics
Kharkiv, Ukraine

Vladimir Kartashov

Kharkiv National University of Radio Electronics
Kharkiv, Ukraine

Oleg Zubkov

Kharkiv National University of Radio Electronics
Kharkiv, Ukraine

Vladimir Oleynikov

Kharkiv National University of Radio Electronics
Kharkiv, Ukraine

Ivan Selieznov

Kharkiv National University of Radio Electronics
Kharkiv, Ukraine

Michail Anohin

Kharkiv National University of Radio Electronics
Kharkiv, Ukraine

I. Koryttsev *et al.*, "Practical Aspects of Range Determination and Tracking of Small Drones by Their Video Observation," *2020 IEEE International Conference on Problems of Infocommunications. Science and Technology (PIC S&T)*, 2020, pp. 318-322, doi: 10.1109/PICST51311.2020.9468047.

<https://ieeexplore.ieee.org/document/9468047>

DOI: [10.1109/PICST51311.2020.9468047](https://doi.org/10.1109/PICST51311.2020.9468047)

Abstract—Different methods used for drones detection and estimation of their parameters (radar, acoustical, optical etc.). Among them optical methods can perform an important role in a precise definition of drones' coordinates, their tracking and recognition. The paper is devoted to the primary signal processing in the passive optical system with two channels of video observation and photosensitive matrices. The considered configuration of the optical system allows estimate a distance from a drone and realize its angle tracking on the base of measuring linear parallaxes of drones light images projected onto matrices. Experimental results include corrections of lens distortions.

Keywords—angle tracking; DJI Phantom; motion detection; quadcopter; range estimation; stereo video observation; UAV; video stream.

REFERENCES

- [1] L. Shapiro and G. Stockman, *Computer Vision*, Prentice Hall, pp. 617, 2001.
- [2] L. Lindner, O. Sergiyenko, J.C. Rodríguez-Quinonez, M. RivasLopez, D. Hernandez-Balbuena, W. Flores-Fuentes, et al., "Mobile robot vision system using continuous laser scanning for industrial application", *Industrial Robot*, vol. 43, no. 4, pp. 360-369, 2016.
- [3] J. Mrovlje and D. Vrancic, "Distance measuring based on stereoscopic pictures", *Proc. 9th International PhD Workshop on Systems and Control*, pp. 6, 2008.
- [4] S. Chaudhuri and A.N. Rajagopalan, *Depth from Defocus: A Real Aperture Imaging Approach*, Washington:Springer, pp. 172, 1999.
- [5] V. Kartashov, V. Oleynikov, I. Koryttsev, O. Zubkov, S. Babkin and S. Sheiko, "Processing and Recognition of Small Unmanned Vehicles Sound Signals", *International Scientific-Practical Conference on Problems of Infocommunications Science and Technology PICS and T 2018*, pp. 392-396, 31, January 2019.
- [6] V. N. Oleynikov, O. V. Zubkov, V. M. Kartashov, I. V. Koryttsev, S. I. Babkin and S.A. Sheiko, "Investigation of detection and recognition efficiency of small unmanned aerial vehicles on their

- acoustic radiation", *Telecommunications and Radio Engineering*, vol. 78, no. 9, pp. 759-770, 2019.
- [7] R. Szeliski, "Computer Vision: Algorithms and Applications", pp. 812, 2011.
- [8] R. Y. Tsai, "A versatile camera calibration technique for high-accuracy 3D machine vision metrology using off-the-shelf TV cameras and lenses", *IEEE Int. Journal on Robotics and Automation*, vol. 3, pp. 323-344, 1987.
- [9] R. Cipolla, T. Drummond and D. Robertson, "Camera calibration from vanishing points in images of architectural scenes", *BMVC*, pp. 382-391, September 1999.
- [10] Z. Zhang, "Flexible New Technique for Camera Calibration", *IEEE Transaction on Pattern Analysis and Machine Intelligence*, vol. 22, no. 11, pp. 1330-1334, 2000.
- [11] J. Y. Bouguet, MATLAB calibration tool, [online] Available: http://www.vision.caltech.edu/bouguetj/calib_doc/.
- [12] V. Kartashov, V. Oleynikov, O. Zubkov and S. Sheiko, "Optical detection of unmanned air vehicles on a video stream in a real-time", *The Fourth International Conference on Information and Telecommunication Technologies and Radio Electronics (UkrMiCo'2019)*, pp. 9-13, September 2019.