

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Grigory Yashin

PhD Program: Engineering Systems

Title of Thesis: Development of group of flying robots with multifunctional robotic limbs aimed at operations in cluttered environments

Supervisor: Associate Professor Dzmitry Tsetserukou

Name of the Reviewer: Andrey Somov, CDISE, Skoltech

I confirm the absence of any conflict of interest

Signature:



Date: 12-11-2020

Reviewer's Report

The thesis reports on the research proposed in the scope of development of the group of flying robots with multifunctional robotic limbs. The research includes three parts (i) aerial manipulator, (ii) VR-based teleoperation system, and (iii) locomotion algorithm. Thesis is well structured and easy to read.

Literature review is deep enough and based on relevant and fresh works.

Motivation is well explained observing the evolution of unmanned aerial vehicles (UAV) with robotics arm over time. While performing the analysis of the state-of-the-art in UAV the author has outlined the gap in a lack of research devoted to teleoperation of flying robotics. As it was shown, the generic ideas on controlling methods have not been proposed. That is why the existing researches are divided into different individual specific research questions while industrial maintenance and assistance in rescue operations require the most versatile robots.

Thesis and developed ideas are aimed at expanding the capabilities of the flying robots in rescue operations and industrial maintenance.

In terms of novelty, the author claimed an idea to remotely control flying robots with a lightweight robotic arm without a direct visual contact between a human operator and a flying robot. The robotic arm is capable of reproducing human hand movements with a tactile feedback for an operator whether the object was grabbed or not. As the second novelty the author claimed the non-traditional

locomotion algorithm for the quadrupedal landing platform called LocoGear. The first novel idea is reasonably obvious, since attaching a camera and manipulator to a quadcopter and watching an online video from the on board camera and controlling the onboard manipulator is not novel and it appeared a long time ago. From the observed research works this idea has novelty at some extent while from an engineering point of view it is not so. The second novel idea looks prominent, as the author does his best to solve the energy efficiency problem from a non-traditional: Grigory proposed the algorithm of locomotion instead of traditional ways of locomotion such as the wheels, for example.

Among the strong points of this work is mathematical modelling of the developed mechanisms. Author used Maple and Matlab for kinematic and dynamic models of robots. Arduino platform was used as the core system in an experimental testbed. However, the author does agree that this platform is truly simple. Prior to assembling the proposed system the author performed fine mechanical calculations and created the block scheme of functional modules.

It should be noted that that according the reviewer opinion a lot of time has been dedicated to mathematical and graphical modelling of the proposed system. Apart from it, the author carried out lots of experiments with a number of participants. Manipulator arm was tested with a variety of objects which were accurately measured.

I do not have any critical comments, as this work has already been discussed via a phone call and all the comments have already been addressed. I wish Grigory good luck at his PhD defense.

Provisional Recommendation

I recommend that the candidate should defend the thesis by means of a formal thesis defense

I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report

The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense