ICUAS ASSOCIATION, INC.

ISSUE 9 - WINTER 2021-22

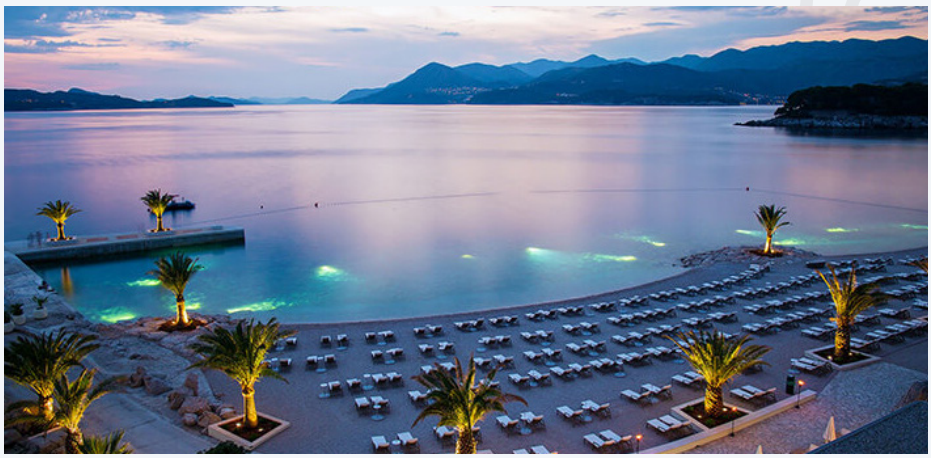
Dear Readers:

Welcome to the Winter 2021-22 Issue of the ICUAS Association Newsletter. In this Issue, we present the latest news and information about ICUAS 2022, and we introduce you to one of the Organizers of ICUAS 2023, Prof. Anna Konert. Prof. Mario Sarcinelli-Filho also reports on research activities at the Federal University of Espirito Santo, Brazil.

ICUAS 2022

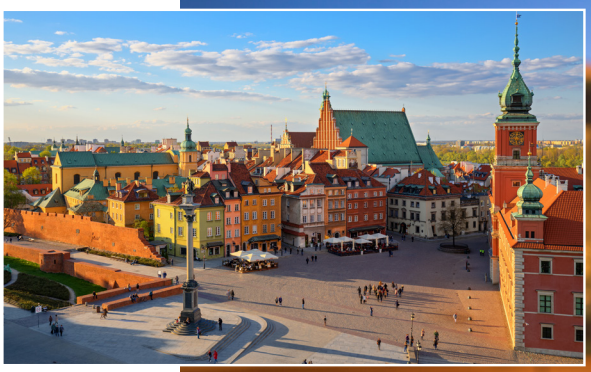
Despite the COVID-19 challenges, we march on, and we are ready to start reviewing papers. The deadline has been extended to February 20, the usual two-week extension; the UAV Competition Rule Book has been published and uploaded on the conference web – all details related to the competition may be found at **http://www.uas-conferences.com/2022_icuas/uav-competition-rulebook-and-faq** the Hotel Room reservation link is live, **https://www.valamar.com/en/meetings/events#icuas.**

Pre-registration will open soon, and we are now working on sponsors and exhibitors, as well as Special Issues that will be announced before the conference. We still aim at a physical presence conference – and we encourage you to be present to witness first hand the competition. All safety protocols at the time of the conference will be observed. We will continue to update you on a regular basis.



ICUAS 2023

The **2023 ICUAS** will take place on **June 6-9**. The Conference will be hosted by **Lazarski University**, Warsaw, Poland. Prof. **Anna Konert** coordinates all activities related to the conference, also will serve as General Chair.



Lazarski University is located in **Warsaw** - capital of Poland. The Warsaw metropolitan area has about 3,3 million inhabitants, making it the 10th most populous urban zone in the EU. Warsaw is also the most ethnically diverse city in the country, and has more universities and colleges than any other Polish city. Warsaw is very welcoming for foreign students, offers many opportunities to build a successful career, and is the perfect city to develop personally, professionally and academically.

Lazarski University is one of the best universities in Poland. In 2020, in the ranking of non-public universities "Perspektywy", Lazarski University came third. Moreover, it is the best Polish university in the international U-Multirank ranking prepared at the request of the European Commission.

Lazarski University has 3 faculties: Faculty of Law and Administration, Faculty of Economics and Management, Faculty of Medicine, PhD Seminar, Foreign Law schools, Foreign language courses, MBA/MPA Studies- inter alia, MBA in Aviation, Postgraduate studies, LL.M. - inter alia, LL.M. in Air Law (conducted in Polish), Aviation Operations with Private Pilot Studies (conducted in English), Aviation Safety Management (SMS).

Faculty of Law and Administration

The Faculty was established in 1997 as the first private law faculty in Poland. Thanks to a consistent strategy and its capacity, comprising recognised academics and practitioners, it has soon become one of the best in Poland. For 15 years, the Law and Administration faculty has been at the top of the ranking "Dziennik gazeta prawna". There is also a successful Student legal clinic at the Lazarski University.

Lazarski Flight Academy

Lazarski Flight Academy offers a brand new simulator centre, and study programme in the field of aviation, conducted with the support of Institute of Air and Space Law at Lazarski University. This programme is: Aviation Law and Professional Pilot Licence (conducted in English).

RESEARCH ACTIVITIES REPORT

ROBOTICS RESEARCH GROUP
DEPARTMENT OF ELECTRICAL ENGINEERING
FEDERAL UNIVERSITY OF ESPÍRITO SANTO
GROUP LEADER: PROF. MARIO SARCINELLI-FILHO

The research group on Robotics of the Department of Electrical Engineering, Federal University of Espirito Santo, settled in Vitória, ES, Brazil, has focused its research activity on aerial aircraft systems, specially dealing with load transportation using quadrotors. We are working on two main aspects of such a subject, the load transportation itself, in this case considering cable suspended loads, and the logistics involved when a delivery drone should land back in a moving truck, after delivering a package.

In the first case, proposals involving the transport of slung point loads by a single UAV or a group of UAVs have been published in the last three years, as well as proposals involving the transportation of rod-shaped slung loads by a formation of two UAVs. With regard to the second case, we have dealt with a formation of a UAV and a UGV, this last one emulating a truck on which the UAV should land, and have published some results in this topic since last year.

Dealing with the transportation of slung loads by one or more UAVs, we have considered the load as a modeled perturbation, and designed controllers able to deal with such a perturbation, so that no demand of sensory information about the load is necessary. The main problem, in such a case, is to avoid oscillations of the load (modeled as a mobile pendulum), since they could mean strong perturbation to the navigation of the UAV to which the load is attached. References [1], [2], [3], and [4], are publications related to point-load transportation, as illustrated in Figures 1 to 3, which present the ideas involved in the proposals we developed in this subject.

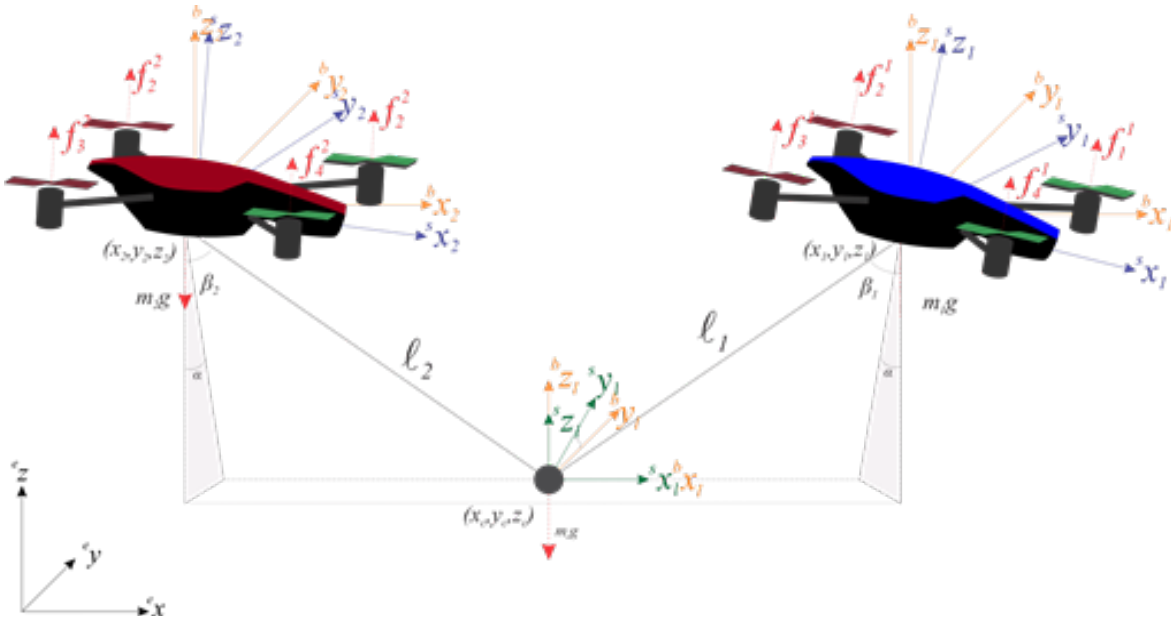


Figure 1: A sketch of two quadrotors transporting a point load suspended by cables attached to them.

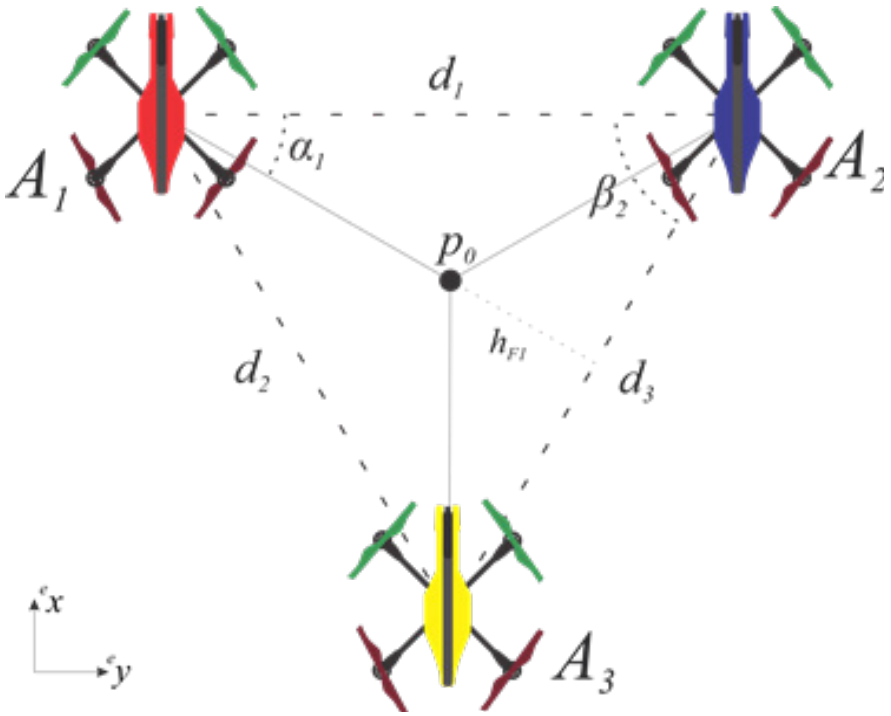


Figure 2: A point load transported by three quadrotors, attached to them through cables (top view).

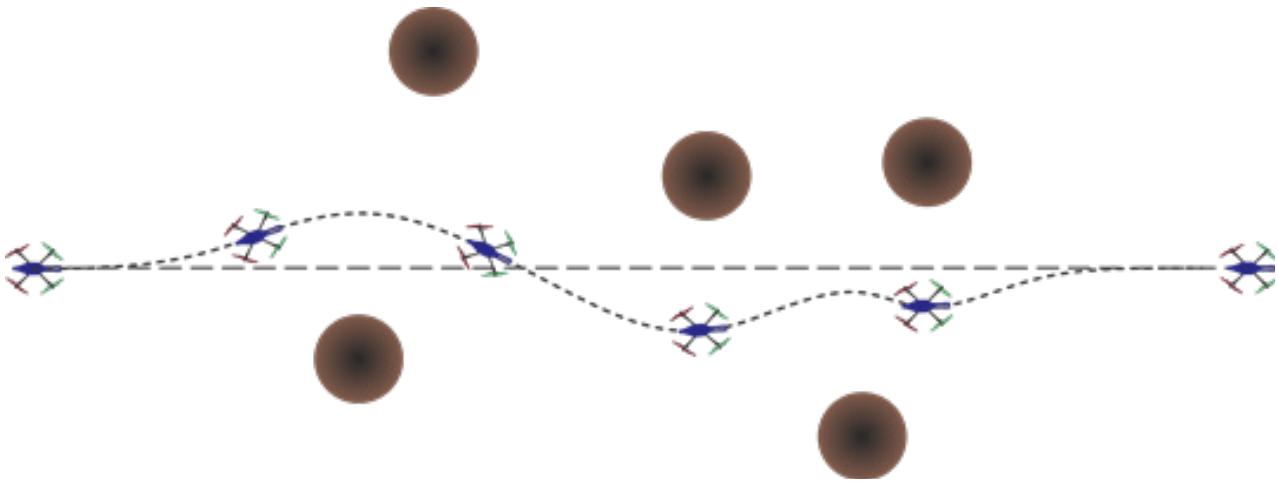


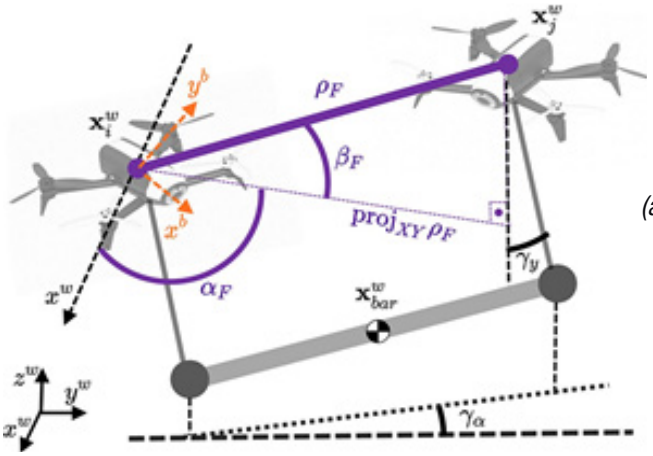
Figure 3: A UAV transporting a cable suspended point load in an environment crowded of obstacles.

Regarding loads other than point loads, we have considered rod-shaped loads, for which the transportation should involve at least two UAVs, as illustrated in Figure 4. Reference [5] brings results for such a case, where the emphasis is put on the control of the two UAVs as a formation, considering low velocities, so that the load is supposed to be stabilized directly below the vehicles. To compensate for any disturbance in this assumption, adaptive control has been adopted. In addition to the transport of the load itself, the proposed structure also allows a certain manipulation of the load, such as its rotation or a tilt movement, moving up or down one of its extremities.

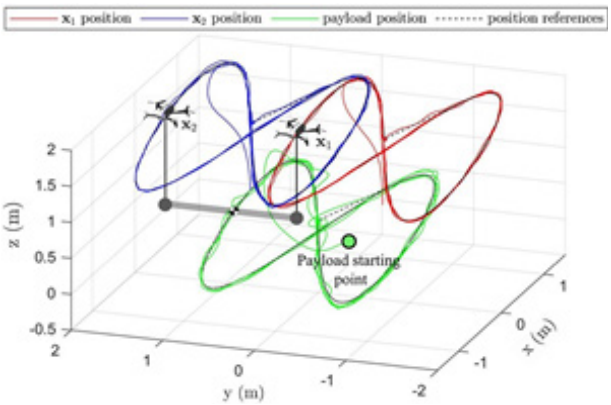
Still regarding non-point loads, we have also dealt with a triangular plate, discussing somewhat the possibility of manipulating such a load. In this case, as shown in Figure 5, three UAVs are used to transport the load, to better fit the load being transported, as discussed in [6].

Regarding the research related to the UAV-UGV formation, we have dealt with this specific formation thinking on the last step of the last mile delivery, when the delivery drone should land back in a small truck in movement. The research uses a UGV to mimic the truck, and both vehicles are con- trolled in such a way that guarantees that the drone is just above the UGV to start the land procedure.

When developing such control system we have considered also the possibility that the UGV can be deviating from an obstacle, and in such a situation the drone should also make the same maneuver. References [7] and [8] are publications dealing with this specific problem, using the heterogeneous formation illustrated in Figure 6. For the particular case in which the UAV should land on the UGV, a singularity appears just when the UAV is above the UGV, which is the configuration of interest to start the landing procedure. T deal with this singular configuration we have adopted a quaternion- based representation of the formation, and proposed a controller based on such a representation, as discussed in [9].



(a) A system sketch



(b) Trajectory-tracking by the load

Figure 4: Transporting a rod-shaped load using two quadrotors.

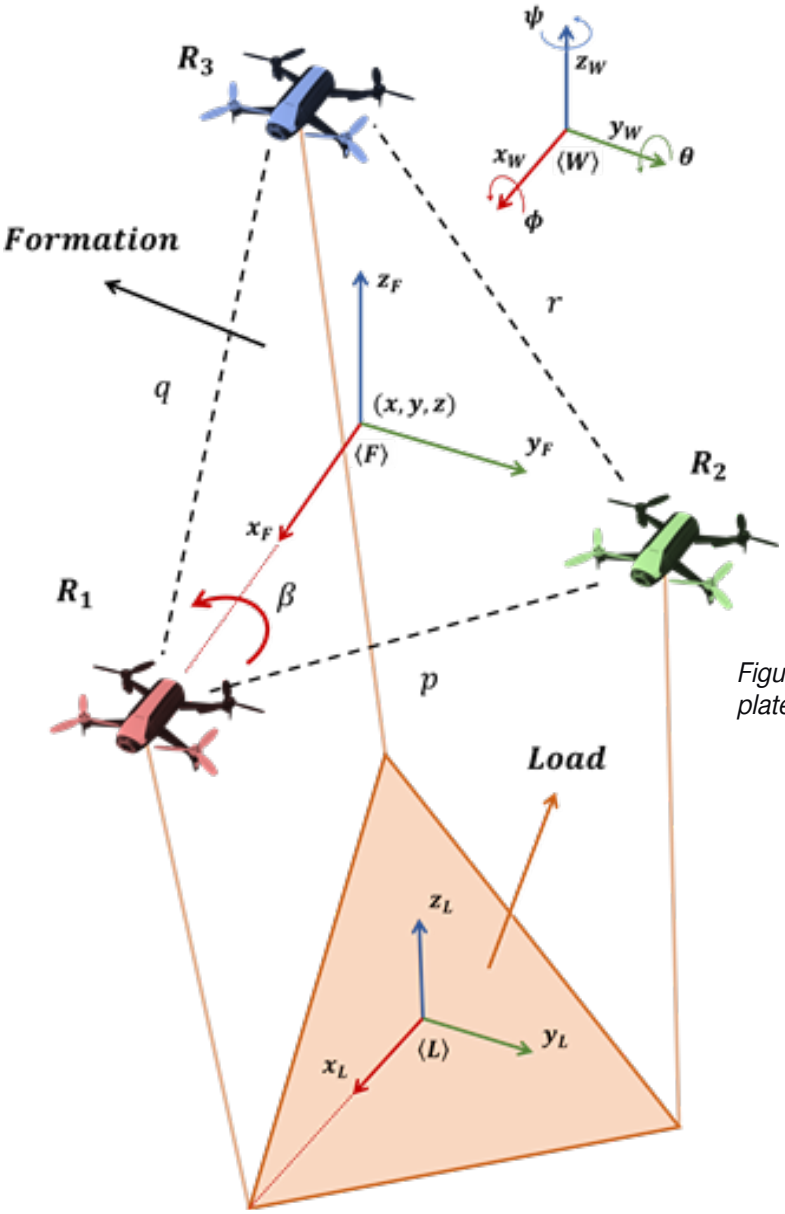


Figure 5: Transporting a triangular plate with three quadrotors.

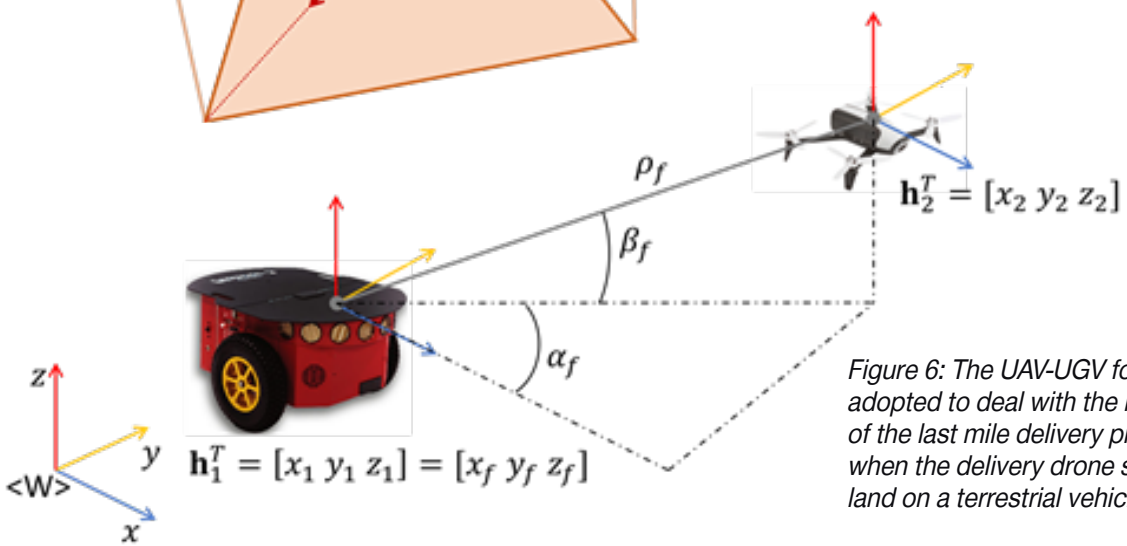


Figure 6: The UAV-UGV formation adopted to deal with the last step of the last mile delivery problem, when the delivery drone should land on a terrestrial vehicle.

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Mario Sarcinelli-Filho received the B.S. degree in electrical engineering from the Federal University of Espírito Santo, Brazil, in 1979, and the M.Sc. and Ph.D. degrees in electrical engineering from the Federal University of Rio de Janeiro, Brazil, in 1983 and 1990, respectively. He is currently a Professor with the Department of Electrical Engineering, Federal University of Espírito Santo, Brazil, and a Researcher with the Brazilian National Council for Scientific and Technological Development(CNPq). He has coauthored more than 65 journal articles, more than 350 conference papers, and 17 book chapters. He has also advised 20 Ph.D. students and 26 M.Sc. students. His research interests include nonlinear control, mobile robot navigation, coordinated control of mobile robots, unmanned aerial vehicles, and coordinated control of ground and aerial robots. He is also a Senior Editor of the Journal of Intelligent and Robotic Systems and a member of the Brazilian Society of Automatics.

ICUAS Association News

To better serve you, we have upgraded our website and we have made it more reader friendly. We still encourage you to submit information about your projects, laboratory, research findings, etc., which will be uploaded under the "External Projects" entry. You also may submit a write up on project results, or a link that summarizes your research activities, a video of a successful flight, or any other accomplishment. Please submit the information to kvalavanis@gmail.com.

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