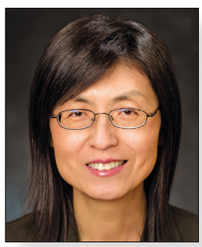
Robots From Above: Extending Our Reach

By Yi Guo

From the earliest time to the present, humans have sought to extend their reach by designing new tools and gadgets. Weather balloons have been used for over 150 years to carry meteorologic instruments for weather prediction, storm forecasting, and climate change research. Unmanned aerial vehicles (UAVs), also known as drones, were initially developed as radio-controlled aircraft during the First World War. Nowadays, UAVs are used in agriculture, construction, insurance, and infrastructure inspection, and the commercial market of drones has been fast growing [1]. Drones are also very helpful in public sectors and have been used in search and rescue tasks, such as spotting a missing person in mountainous terrain or dropping a lifesaving vest to a person in danger of drowning at sea.

In this June issue of the magazine, we assemble a set of feature articles presenting innovative research on aerial robotics. These articles were submitted to the regular article track of the magazine in the past two years and were accepted after rigorous peer review. The first article, by Petracek et al. [A1], describes cooperating UAVs autonomously flying in historical monuments for digital documentation of large interiors of buildings. The authors overcame challenges, including difficult-to-access areas and low lighting conditions in real-world scenarios, and achieved collision-free navigation and precise digital documentation. The second article, by Jeger et al. [A2], presents the control of an autonomous balloon for outdoor path planning and navigation. The balloon motion system has high complexity, including one degree of actuation, nonholonomic constraints, and wind-dependent stochastic motion. An innovative reinforcement learning method was developed for the problem, which was difficult to solve with classic path planning methods. Outdoor field testing demonstrated successful balloon flight over a 10-km distance within 1.5 h.



Following the two articles with impressive real-world demonstrations, three articles in this issue extend the capability of flying robots with added manipulation. The work by Anzai et al. [A3] presents articulated aerial robots that can pick and place objects in outdoor fields. Innovative hardware designs (i.e., a grasping gripper and tiltable camera) were integrated with algorithms of sensing and control, and autonomous pick and place tasks were successfully performed in a real field robotics challenge. The article by Zhang et al. [A4] presents aerial manipulation for a torch relay, where an integrated UAV and manipulator system light a torch and perform a relay in an ice-and-snow field at a Winter Olympics site. Aerial manipulation for transportation and assembly is described in the article by Gorlo et al. [A5], and the authors' contribution includes an innovative ring shape and gripper design for precise placement of heavy poles.

While a single UAV is hard enough to control, the article by Buzcu et al. [A6] presents a study on efficient, privacy-preserving, reliable, and secure multi-UAV service delivery leveraging blockchain technology and reputation-based teamwork. Two articles in this issue extend the reach to space. Takemura and Ishigami [A7] developed a new trajectory planning method for a planetary exploration rover in their article. Delgado-Centeno et al. [A8] used real lunar surface image data collected by a NASA satellite and showed how machine learning methods can enhance data products for future planetary exploration missions.

Last but not least, two Reproducible articles are included in this issue that report fully reproducible experiments. The article by Wiebe et al. [A9] presents the control of underactuated robots and a demonstration on canonical robotic hardware for a benchmarking study. The article by Cervera [A10] presents software methods for automatically building a reproducible binary package of a source code repository and describes practical examples with hands-on instructions.

I am excited to see these articles printed for broader dissemination. I personally think that the featured articles represent the state of the art in aerial robotics research, and their real-world experiments clearly demonstrate that

(continued on page 7)

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flexibility, distributing the review workload more evenly throughout the year. Coupled with the option to present journal articles at conferences, this hybrid model could see mature work published in journals showcased alongside preliminary ideas.

However, some concerns linger. Publishing in a journal demands a higher standard of work, and many less impactful contributions may be left unpublished. Conferences could become more exclusive, disproportionately impacting underprivileged communities. A compromise would need to be found, for instance, through the introduction of a two-tier journal.

Eliminating conference papers is akin to abolishing deadlines. Journal submissions can occur at any time throughout the year. Under this model, authors hold sole responsibility for deciding when their work is sufficiently ripe for submission. Some fear that this could lead to procrastination among young researchers, significantly delaying publication submissions. Yet, several highly successful scientific communities operate within deadline-free models.

Deciding on the best model and the path forward is complex. We began collecting feedback at the ICRA 2024 Townhall, where conference attendees engaged in a lively debate to explore these questions further. We want to hear from you as well! Scan the QR code (passcode: ICRA2024), and let us know what you think.

Alternatively, visit https://app.sli.do/event/s2tbREKEYph7f1skLxZUzf (passcode: ICRA2024) to access the poll.

FROM THE EDITOR'S DESK *(continued from page 4)*

robots from above can extend humans' reach in various applications that are beneficial to society. I hope you enjoy reading the issue!

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APPENDIX: RELATED ARTICLES

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