Advances in Control of Autonomous Aerial Vehicles
– Contributed Book –

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Preface

The idea of this contributed book sparked throughout a conversation among us editors about the state-of-the-art in control theory and its applications to aerospace systems in general and unmanned systems in particular. With our research activities, our roles on the editorial board of the IEEE Transactions of Aerospace and Electronic Systems (Dr. Inalhan serves as the Editor-in-Chief, Dr. L'Afflitto serves as the senior editor of the Autonomous Systems track, and Dr. Shin serves as an associate editor within the same track), and our active involvement in professional societies such as AIAA and IEEE (for instance, Dr. Inalhan is the Chair of the IEEE Committee on Aerospace Control, Dr. L'Afflitto has been a long-standing member of the same committee, and Dr. Shin has been a member of the IFAC TC on Aerospace for many years), we believed to have a unique perspective on the rapidly expanding scientific literature in this area of great interest to academicians, commercial entities, and simple amateurs. We also felt that, despite the nourished scientific literature on control systems theory for autonomous aerospace systems, our community has been lacking a book that provides both breadth and depth on the state-of-the-art. Indeed, we wanted to create a book that any graduate student in control theory with some competencies in dynamics and control of aerospace systems could use as a starting point for their research and become aware of some key trending research topics. Furthermore, we wanted to create a book that could have been used as a primary or complementary textbook for some graduate special topics class on autopilot design for aerospace systems or closely related topics.

The aerospace controls community is populated by world-class researchers who had truly game-changing impacts both in control theory and in aerospace applications. Furthermore, this community is nourishing several raising stars who already contributed in a significant manner to advance control theory and realize autonomous aerospace systems, which would have been considered visionary a decade ago. Thus, we reached out to some of these outstanding figures asking for a contribution presenting both some of their latest results and some detailed discussion on the state-of-the-art in their sub-disciplines.

This edited book provides in a single volume a snapshot of the state-of-the-art in the field of control theory applied to the design of autonomous unmanned aerial

vehicles (UAVs) employed in a variety of civilian applications. Its homogeneous structure allows the reader to seamlessly transition from results in guidance, navigation, and control of UAVs, according to the canonical classification of the main components of a UAV's autopilot. The contributing authors duly presented detailed literature reviews, conveyed their arguments in a systematic way with the help of diagrams, plots, and algorithms, and showcased the applicability of their results by means of flight tests and numerical simulations whose results are discussed in great detail. In several cases, the authors made available their codes and their simulation or flight test results on their research websites or open-access repositories. Sharing these data sets allows the interested reader to better appreciate the proposed results and use them as benchmarks for their own works. No edited book on the control of UAVs can be omni-comprehensive. Thus, in the first and last chapters of this work, we recommend numerous textbooks and very recent survey papers on the design of autopilots for UAVs and other aerial robots to further enhance the readers' learning experience. Finally, each chapter has been edited to employ some common language and guarantee a good level of consistency throughout this work.

The growing demand for trustworthy autonomy in general and reliable, user-friendly autonomous aerial systems to be employed in numerous and diverse applications, which range from agriculture to surveillance, last-mile payload delivery, and people transportation across cities, assures that this field will continue expanding in the next decades, and, perhaps, will become a classical ever-lasting area of study. We do hope that this editorial effort will serve current and future generations of researchers and practitioners to thrive in autonomous aerospace control systems design.

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