

Vertical Take-off and Landing Platform for Cartography and Local Governance Consulting

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Abstract

Unmanned aerial vehicles (UAVs) have received much attention due to their capabilities to generate high-resolution aerial photographs that allow the creation of maps that can support the local governance of different communities. Aeronautical cartography is limited in rural communities due to different factors, such as bureaucratic, economic requirements, and the lack of access to state-of-the-art tools for territorial management and consultation in local governance undertakings. In this work, we describe a UAV with vertical take-off and landing (VTOL) capabilities. This aircraft is designed as a versatile platform for image acquisition to assist local governance activities within Mexican rural communities. Equipped with a multispectral camera and GNSS/GPS with a PPK system allows for high precision photogrammetry and a high precision time register of the photographs. A case study is carried out to demonstrate the series of advantages over conventional UAVs, specifically in payload, flight time capabilities, and, more importantly, as a robust and versatile platform to perform local governance and territorial management activities. This VTOL platform can be used from any terrain, allowing rural communities in areas with complicated geographies to use it. While we have developed a promising VTOL platform for cartography and local governance activities, a series of considerations and improvements remain. Employing a UAV with VTOL characteristics could empower local communities in their local governance activities, such as planning, zoning bylaws, land conservation, and collaboration with other communities.

Keywords

VTOL, UAV, Local Governance

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Joaquín Aguerrebere is a Master's student in engineering science at Universidad Iberoamericana in Mexico City. Also, he is the co-founder of Libedron, a company dedicated to the design, implementation, flight and development of new drone technologies. Joaquín holds a Bachelor degree in mechatronics and production engineering from Universidad Iberoamericana. He is an active collaborator in developing joint projects with Universidad Iberoamericana aimed at advancing social welfare.

José Emilio Quiroz-Ibarra is a professor at Universidad Iberoamericana, Ciudad de México. He received his PhD degree from Universidad Iberoamericana, Ciudad de México and the Master degree from Fundación Arturo Rosenblueth in Computer Science, the Bachelor's degree from UNAM in Electronics and Communications Engineering. He works in the research of complex algorithms, databases and data structures models and Data Science methods. He has several collaborations in indexed magazines and international congresses.

Juan Manuel Núñez is a Professor at the Universidad Iberoamericana Ciudad de México. PhD (2017) and MSc (2006) in Geomatics at CentroGeo. Bachelor's Degree (2004) in Geodesy and Surveying Engineering at UNAM. He works at research line geomatics for sustainability. He has several collaborations in indexed magazines, book's chapters and national and international proceedings. Since January 2019, he has been a member of the Mexican National Researchers Registry.

Jorge Ángel González-Ordiano is a Professor at the *Universidad Iberoamericana Ciudad de México*. He received his Bachelor (2014), Master (2016), and PhD (2019) degrees in Mechanical Engineering from the Karlsruhe Institute of Technology (KIT) in Germany. His PhD focused on using data science to aid the energy transition and was part of the Helmholtz Association's Energy System 2050 project. After receiving his PhD, he joined the Colorado State University as a postdoctoral research fellow, where he worked within the lab of Professor Steve Simske. During that period, his research consisted in developing methods to combat illicit trade using data science. Currently, Dr González-Ordiano is interested in researching new applications of data science in different areas.

Eduardo Gamaliel Hernandez-Martinez received is an Electronics Engineer (process control and instrumentation), MSc and PhD in Electrical Engineering (mechatronics section) from CINVESTAV, Mexico. His research areas encompass theory and applications of dynamical systems and control, multi-robot motion coordination, discrete-event systems and the focus of multi-agent systems in complex networks (urban traffic networks, social networks, manufacturing systems, smart grids, thermodynamics, among others.). Also, he has experience in applied research and technological development in drones and autonomous vehicles. Currently, he is the Head and researcher at the Institute of Applied Research and Technology, Universidad Iberoamericana, Mexico City.

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Guillermo Fernández-Anaya received the Ph.D. degree in electrical engineering from the Universidad Nacional Autonoma de Mexico in 1995. He is currently a Full Professor at the Universidad Iberoamericana, Mexico. He has published more than 120 journal papers, 130 conference papers, ten chapters in books, and three books. He has reviewed articles for more than 35 different scientific journals and several international congresses. He has participated in several conferences organizing committees. His research interests include mathematical control theory, preservation theory in systems, synchronization in nonlinear systems, applications to econophysics, differential equations of noninteger order, and other fields. He is a member of the editorial board in several scientific journals and served as a Guest Editor of the Journal of the Franklin Institute. He is a member of the New York Academy of Sciences and other scientific societies.