Framework of key enabling technologies for safe and autonomous drones’ applications

Results

Project Information

COMP4DRONES

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Overall budget

€ 29 391 259,83

EU contribution

€ 7 973 441,62

Coordinated by

INDRA SISTEMAS S.A.
Spain

Deliverables

Documents, reports (14)

Project Handbook

The project handbook constitutes a set of project templates, explanations on the project management process, review process, quality checks, meeting organization, which is communicated to all partners. Delivered by T8.1

Methodology and workflow v1

1st version [D2.2] • Evaluation of state-of-the-art frameworks and methodologies identifying the necessary extension, and description of the methodology and workflow to use when using the COMP4DRONES framework.
 Specification of an Industrial Use Cases

A combined report will be given on the specification of the use cases. A detailed description will be given on each use case, its functions, area, and way of application, components used, and its boundary conditions.

Drones regulations compliance handbook

Document that presents the main expectations of the Authorities in terms of qualification and the main design rules in order to ease the obtaining of a permit-to-fly.

Architecture for Communications and Security v1

First version [D5.1] This deliverable will define the trusted communication framework architecture and specify the modules that will be designed in WP5, ensuring communication reliability and security. Plans for tool development and/or improvement with their corresponding final TRL will be outlined.

Specification of integrated and modular architecture for drones v2

This deliverable, linked to tasks T3.1 and T3.2, will provide specifications of standardized software framework for drones. These specifications cover the modular software architecture, the hardware independence interface, and the communication architecture between modules and layers of the architecture.

System Under Test Requirements and Test System Requirements v1

A combined report on use case requirements will be given. This report will define two different kinds of requirements. On the one side, functional requirements on the system under test will be defined. On the other side, non-functional requirements on the test system will be defined. This document will be delivered in a preliminary and a final version.

Data Management Plan

The DMP will provide an analysis of the main elements of the data management policy that will be used by the applications with regard to all the datasets that will be generated by the project. The DMP is not a fixed document, but evolves (if necessary) during the lifespan of the project. According to the Guidelines on Data Management in Horizon 2020, the DMP should address data set reference and name, data set description, standards and metadata, data sharing and archiving and preservation (including storage and backup) on a dataset by dataset basis and should reflect the current status of reflection within the consortium about the data that will be produced.

Specification of integrated and modular architecture for drones v1

This deliverable, linked to tasks T3.1 and T3.2, will provide specifications of standardized software framework for drones. These specifications cover the
modular software architecture, the hardware independence interface, and the communication architecture between modules and layers of the architecture

**Training Strategy and Plan**
The deliverable will identify the target audience, the training modules to be developed and the associated planning and scheduling of training development and quality control and reporting of initial courses.

**Design Technology background**
This deliverable will describe the design methods and tools put by the technology partners as background technology. Initial TRL will be provided. Plans for tool development and/or improvement with their corresponding final TRL will be outlined

**Framework specification**
Specification of the COMP4DRONES framework capabilities.

**Methodological guide on sensory systems and data aggregation for drone’s platforms**
This deliverable will provide a public available report that will include description of methodologies and sensory system as well as data aggregation algorithms for universal autonomous navigations systems for drones. This deliverable will include specifications and definitions of sensory systems, their role and will define algorithms and strategies of sensory fusion for pre-processing sensory information in drone’s platforms.

**Implementation of integrated and modular architecture for drones v1**
This deliverable will provide an implementation report of the reference architecture. In particular, (1) description and guidelines of the implementation of the modular component-based autopilot, (2) software communication architecture, and (3) standardized API enabling easy safe integration and interfacing of components. Developer guides and application programming interfaces will be provided. The maturity of the architecture and components is assessed by the industrial use-cases of WP1.

**Other (4)**

**Press kit v1**
This deliverable will provide the first iteration of project specific materials to summarize objectives, target audience, technology results and expected impact from the project for industries targeted by COMP4DRONES.

**Web presence and periodic update**
This deliverable will provide publicly available project information including introduction to the project and objectives, the partners involved, the expected results and the impact the results will have on the targeted industries. Publicly available deliverables will be made available for download. Additionally, it will include other web related presence such as twitter page and LinkedIn project page.

Press kit v2
This deliverable will provide the first iteration of project specific materials to summarize objectives, target audience, technology results and expected impact from the project for industries targeted by COMP4DRONES. • 1st update of presentation, brochure, and leaflet; new video1) [D7.3]

Press kit v3
This deliverable will provide the first iteration of project specific materials to summarize objectives, target audience, technology results and expected impact from the project for industries targeted by COMP4DRONES. • (2nd update of presentation, brochure, and leaflet; new video2) [D7.4]

Publications

Conference proceedings (26)

Multi-Layered CP-ABE Scheme for Flexible Policy Update in Industry 4.0

Author(s): Aintzane Mosteiro-Sanchez, Marc Barcelo, Jasone Astorga, Aitor Urbieta
Published in: 2021 10th Mediterranean Conference on Embedded Computing (MECO), 2021, Page(s) 1-4
DOI: 10.1109/meco52532.2021.9460263

Interpolating Control Based Trajectory Tracking

Author(s): Zdenek Boucek, Miroslav Flidr
Published in: 2020 16th International Conference on Control, Automation, Robotics and Vision (ICARCV), 2020, Page(s) 701-706
DOI: 10.1109/icarcv50220.2020.9305511


Author(s): David Derler, Sebastian Ramacher, Daniel Slamanig, Christoph Striecks
Published in: 25th International Conference on Financial Cryptography and Data
Co-simulation Framework for Virtual V&V of GNC Algorithms for Autonomous UAV

**Author(s):** V. Dezobry, F. Cappuzzo, S. Di Gennaro; D. Bianchi

**Published in:** NAFEMS World Congress 2021, 2021

Building Blocks and Interaction Patterns of Unmanned Aerial Systems

**Author(s):** Mahmoud Hussein Reda Nouacer

**Published in:** EUROMICRO Digital System Design Conference (DSD 2021), Issue annual, 2021

Key Enabling Technologies for Drones

**Author(s):** M. Hussein, R. Nouacer, Y. Ouhammou, E. Villar, F. Corradi, C. Tieri, R. Castiñeira

**Published in:** IEEE proc. of the 2020 Conference on Digital System Design, DSD 2020, Issue August 2020, 2020

A Low Cost and Flexible Power Line Communication Sensory System for Home Automation

**Author(s):** Mirco Muttillo, Vittoriano Muttillo, Luigi Pomante, Leonardo Pantoli

**Published in:** 2020 IEEE International Workshop on Metrology for Industry 4.0 & IoT, 2020, Page(s) 191-196

**DOI:** 10.1109/metroind4.0iot48571.2020.9138191

Robust Sampled-Data Consensus-Based Cooperative Control of Multi–UAVs

**Author(s):** M. Di Ferdinando, P. Pepe, S. Di Gennaro

**Published in:** 2021 29th Mediterranean Conference on Control and Automation (MED), 2021, Page(s) 167-172

**DOI:** 10.1109/med51440.2021.9480249

GPS-Assisted Feature Matching in Aerial Images with Highly Repetitive Patterns

**Author(s):** Gonzalo Raimundo Luzardo Morocho, Michiel Vlaminck, Dionysios Lefkaditis, Wilfried Philips, Hiep Luong

**Published in:** 2021 IEEE International Geoscience and Remote Sensing Symposium (IGARSS), Issue July 2021, 2021, Page(s) 1-4

Towards a Model-based Multi-Objective Optimization Approach For Safety-Critical Real-Time Systems

**Author(s):** Soulimane Kamni, Yassine Ouhammou, Antoine Bertout, Emmanuel Grolleau
velink - A Blockchain-based Shared Mobility Platform for Private and Commercial Vehicles utilizing ERC-721 Tokens

Author(s): Dominic Pirker, Thomas Fischer, Harald Witschnig, Christian Steger
Published in: 2021 IEEE 5th International Conference on Cryptography, Security and Privacy (CSP), 2021, Page(s) 62-67
DOI: 10.1109/csp51677.2021.9357605

A Vision-Based Algorithm for a Path Following Problem

Author(s): Mario Terlizzi, Giuseppe Silano, Luigi Russo, Muhammad Aatif, Amin Basiri, Valerio Mariani, Luigi Iannelli, Luigi Glielmo
Published in: 2021 International Conference on Unmanned Aircraft Systems (ICUAS), 2021, Page(s) 1630-1635
DOI: 10.1109/icuas51884.2021.9476777

Run-time Monitoring and Trace Analysis Methodology for Component-based Embedded Systems Design Flow

Author(s): V. Muttillo, G. Valente, L. Pomante, H. Posadas, J. Merino, E. Villar

An efficient FPGA-based co-processor for feature point detection and tracking

Author(s): Toms Sturmanis, Rihards Novickis
Published in: 2021 24th Euromicro Conference on Digital System Design (DSD), 2021, Page(s) 24-29
DOI: 10.1109/dsd53832.2021.00013

Data flow analysis from UML/MARTE models based on binary traces

Author(s): H. Posadas, J. Merino, E. Villar
Published in: DCIS 2020 (accepted), 2020

A Comparison of Uncertainty Estimation Approaches in Deep LearningComponents for Autonomous Vehicle Applications

Author(s): Fabio Arnez, Huascar Espinoza, Ansgar Radermacher and François Terrier
Published in: AISafety 2020, 2020
Modeling, implementation, and analysis of XRCE-DDS applications in distributed multi-processor real-time embedded systems

**Author(s):** Saeid Dehnavi, Dip Goswami, Martijn Koedam, Andrew Nelson, Kees Goossens  
**Published in:** 2021 Design, Automation & Test in Europe Conference & Exhibition (DATE), 2021, Page(s) 1148-1151  
**DOI:** 10.23919/date51398.2021.9474221

ECSEL Comp4Drones: hyperspectral-based UAV imaging platform

**Author(s):** Michiel Vlaminck, Murali Jayapala, Bart Masschelein, Roel Vandebriel, Yuqian Li, Jan Leyssens Hiep Luong  
**Published in:** Collaborative Workshop on Architectures of Smart Camera Systems (WASC’20), Issue December 2020, 2020, Page(s) 1-2

Framework of Key Enabling Technologies for Safe and Autonomous Drones’ Applications

**Author(s):** Reda Nouacer, Huascar Espinoza Ortiz, Yassine Ouhammou, Rodrigo Castineira Gonzalez  
**Published in:** 2019 22nd Euromicro Conference on Digital System Design (DSD), 2019, Page(s) 420-427  
**DOI:** 10.1109/dsd.2019.00067

Towards an Architecture for Customizable Drones

**Author(s):** Mahmoud Hussein, Réda Nouacer  
**Published in:** 2020 IEEE 44th Annual Computers, Software, and Applications Conference (COMPSAC2020), 2020

System Simulation for Autonomous UAV Design

**Author(s):** Federico Cappuzzo, Kenedy Matiasso Portella, Jean-Patrick Mascomère, Guillaume Thalmann, Raphael Lallement  
**Published in:** Proceedings of the 2021 Drone Systems Engineering and Rapid Simulation and Performance Evaluation: Methods and Tools Proceedings, 2021, Page(s) 36-45  
**DOI:** 10.1145/3444950.3444952

Unmanned Vehicles in Smart Farming: a Survey and a Glance at Future Horizons

**Author(s):** Daniel Madroñal, Francesca Palumbo, Alessandro Capotondi, Andrea Marongiu  
**Published in:** Proceedings of the 2021 Drone Systems Engineering and Rapid Simulation and Performance Evaluation: Methods and Tools Proceedings, 2021, Page(s) 1-8  
**DOI:** 10.1145/3444950.3444958
Towards a Modular and Customisable Model-Based Architecture for Autonomous Drones

Author(s): Matheus Ladeira, Yassine Ouhammou and Emmanuel Grolleau

Trust-Provisioning Infrastructure for a Global and Secured UAV Authentication System

Author(s): Dominic Pirker, Thomas Fischer, Harald Witschnig, Christian Steger
Published in: 2020 International Conference on Broadband Communications for Next Generation Networks and Multimedia Applications (CoBCom), 2020, Page(s) 1-6
DOI: 10.1109/cobcom49975.2020.9174131

Designing Drone Systems with Papyrus for Robotics

Author(s): Ansgar Radermacher, Matteo Morelli, Mahmoud Hussein, Reda Nouacer
DOI: 10.1145/3444950.3444956

With a Little Help from My Friends: Constructing Practical Anonymous Credentials

Author(s): Lucjan Hanzlik, Daniel Slamanig
Published in: 28th ACM Conference on Computer and Communications Security - ACM CCS 2021, 2021

Peer reviewed articles (13)

Solar Panel Detection within Complex Backgrounds Using Thermal Images Acquired by UAVs

Author(s): Jhon Jairo Vega Díaz, Michiel Vlaminck, Dionysios Lefkaditis, Sergio Alejandro Orjuela Vargas, Hiep Luong
Published in: Sensors, Issue 20/21, 2020, Page(s) 6219, ISSN 1424-8220
DOI: 10.3390/s20216219

Towards a framework of key technologies for drones

Author(s): Réda Nouacer, Mahmoud Hussein, Huascar Espinoza, Yassine Ouhammou, Matheus Ladeira, Rodrigo Castiñeira
Published in: Microprocessors and Microsystems, Issue 77, 2020, Page(s) 103142, ISSN 0141-9331
DOI: 10.1016/j.micpro.2020.103142
A Composable Monitoring System for Heterogeneous Embedded Platforms
Author(s): Giacomo Valente, Tiziana Fanni, Carlo Sau, Tania Di Mascio, Luigi Pomante, Francesca Palumbo
Published in: ACM Transactions on Embedded Computing Systems, Issue 20/5, 2021, Page(s) 1-34, ISSN 1539-9087
DOI: 10.1145/3461647

MAT-Fly: An Educational Platform for Simulating Unmanned Aerial Vehicles Aimed to Detect and Track Moving Objects
Author(s): Giuseppe Silano, Luigi Iannelli
Published in: IEEE Access, Issue 9, 2021, Page(s) 39333-39343, ISSN 2169-3536
DOI: 10.1109/access.2021.3064758

In-Field Automatic Detection of Grape Bunches under a Totally Uncontrolled Environment
Author(s): Luca Ghiani, Alberto Sassu, Francesca Palumbo, Luca Mercenaro, Filippo Gambella
Published in: Sensors, Issue 21/11, 2021, Page(s) 3908, ISSN 1424-8220
DOI: 10.3390/s21113908

The Multi-Dataflow Composer tool: An open-source tool suite for optimized coarse-grain reconfigurable hardware accelerators and platform design
Author(s): Carlo Sau, Tiziana Fanni, Claudio Rubattu, Luigi Raffo, Francesca Palumbo
Published in: Microprocessors and Microsystems, Issue 80, 2021, Page(s) 103326, ISSN 0141-9331
DOI: 10.1016/j.micpro.2020.103326

Robust Quantized Sampled–Data Stabilization for a Class of Lipschitz Nonlinear Systems With Time-Varying Uncertainties
Author(s): M. Di Ferdinando, B. Castillo-Toledo, S. Di Gennaro, P. Pepe
Published in: IEEE Control Systems Letters, Issue 6, 2022, Page(s) 1256-1261, ISSN 2475-1456
DOI: 10.1109/lcsys.2021.3091202

A Converse Lyapunov–Krasovskii Theorem for the Global Asymptotic Local Exponential Stability of Nonlinear Time–Delay Systems
Author(s): M. Di Ferdinando, P. Pepe, S. Di Gennaro
Published in: IEEE Control Systems Letters, Issue 5/1, 2021, Page(s) 7-12, ISSN 2475-1456
DOI: 10.1109/lcsys.2020.2999988

An early-stage statement-level metric for energy characterization of embedded processors
Author(s): Vittoriano Muttillo, Paolo Giammatteo, Vincenzo Stoico, Luigi Pomante
Published in: Microprocessors and Microsystems, Issue 77, 2020, Page(s) 103200, ISSN 0141-9331
DOI: 10.1016/j.micpro.2020.103200

Securing IIoT using Defence-in-Depth: Towards an End-to-End secure Industry 4.0

Author(s): Aintzane Mosteiro-Sanchez, Marc Barcelo, Jasone Astorga, Aitor Urbieta
Published in: Journal of Manufacturing Systems, Issue 57, 2020, Page(s) 367-378, ISSN 0278-6125
DOI: 10.1016/j.jmsy.2020.10.011

Bloom Filter Encryption and Applications to Efficient Forward-Secret 0-RTT Key Exchange

Author(s): David Derler, Kai Gellert, Tibor Jager, Daniel Slamanig, Christoph Striecks
Published in: Journal of Cryptology, Issue 34/2, 2021, ISSN 0933-2790
DOI: 10.1007/s00145-021-09374-3

How to Survive Identity Management in the Industry 4.0 Era

Author(s): Jasone Astorga, Marc Barcelo, Aitor Urbieta, Eduardo Jacob
Published in: IEEE Access, Issue 9, 2021, Page(s) 93137-93151, ISSN 2169-3536
DOI: 10.1109/access.2021.3092203

Mega-Modeling of complex, distributed, heterogeneous CPS systems

Author(s): Eugenio Villar, Hector Posadas, Rafik Henia, Laurent Rioux
Published in: Microprocessors and Microsystems, Issue 29 August 2020, 2020, Page(s) 103244, ISSN 0141-9331
DOI: 10.1016/j.micpro.2020.103244

Book chapters (3)

Consensus-Based Algorithms for Controlling Swarms of Unmanned Aerial Vehicles

Author(s): Raffaele Carli, Graziana Cavone, Nicola Epicoco, Mario Di Ferdinando, Paolo Scarabaggio, Mariagrazia Dotoli
DOI: 10.1007/978-3-030-61746-2_7

CCA-Secure (Puncturable) KEMs from Encryption with Non-Negligible Decryption Errors
Improving Robustness of Deep Neural Networks for Aerial Navigation by Incorporating Input Uncertainty

Author(s): Valerio Cini, Sebastian Ramacher, Daniel Slamanig, Christoph Striecks
Published in: Advances in Cryptology – ASIACRYPT 2020 - 26th International Conference on the Theory and Application of Cryptology and Information Security, Daejeon, South Korea, December 7–11, 2020, Proceedings, Part I, Issue 12491, 2020, Page(s) 159-190
DOI: 10.1007/978-3-030-64837-4_6

Author(s): Fabio Arnez, Huascar Espinoza, Ansgar Radermacher, François Terrier
DOI: 10.1007/978-3-030-83906-2_17

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