The **ADACORSA project** (May 2020 - October 2023) aimed to advance safety and efficiency for Unmanned Aircraft Systems (UAS) through innovative technology. The project's focal points included the development of functionally redundant and fail-operational sensors for detection, avoidance, Time-of-Flight imagers, and secure landings. These sensors, including a 3D Flash LiDAR, Time-of-Flight imagers, and various RADAR technologies, were designed to ensure reliability and safety under automated flight conditions.

Key Developments

1. **3D Flash LiDAR for UAS Safety**: Developed in collaboration with Infineon Austria AG, the LiDAR system met essential requirements, including field of view, framerate, and safety standards for human interaction. Key advancements included functional safety and fail-operational capability, crucial for UAS reliability in high-risk scenarios.
2. **Redundant Data Processing System**: TUG implemented a live migration setup where data from LiDAR sensors is continuously processed by two data processing systems, enhancing UAS resilience. If one system fails, the other takes over seamlessly, minimizing data loss and operational downtime.
3. **Intrusion Detection and Prevention Systems (IDPS)**: TUG adapted the automotive cybersecurity standard (ISO/SAE 21434) using Threat Analysis and Risk Assessment (TARA) methodologies to fit the UAS context. A virtual drone mission simulator was developed to test real-time responses to cyber threats. ADACORSA also contributed to the cybersecurity landscape by enhancing privacy in cryptographic processes and device onboarding, adding a critical layer of privacy for UAS.
4. **Time-of-Flight (ToF) imagers: The novel approach focus on** low-power devices that integrates hardware with machine learning (ML) for ToF processing. It explores novel sensing designs to reduce energy consumption and errors, although these lead to increased noise and lower resolution. The new sensing method mitigates overexposure and stray light interference, reducing depth measurement resolution and the number of frames by 45-52%. Using specialized ML hardware resulted in lower overall energy consumption.
5. **Sensor Fusion for Safe Landings**: Safe landing is a critical function for autonomous UAS, especially in beyond-visual-line-of-sight (BVLOS) missions. To address this, TUG developed a sensor fusion platform capable of evaluating potential landing zones in real-time. Equipped with RADAR and Time-of-Flight (ToF) sensors , the platform analyzes the landing environment by detecting obstacles, ground surfaces, and height variations.

Project Outcomes and Contributions

Throughout its duration, ADACORSA achieved its objectives by advancing the technology necessary to support resilient, autonomous UAS operations. Notable project outcomes included the development of RADAR systems, which underwent rigorous testing in live migration scenarios to assess system continuity during unexpected disruptions. The cybersecurity innovations addressed the complex cybersecurity landscape of autonomous UAS, providing a structured, risk-aware defence mechanism against potential attacks.

The project also produced 7 significant publications and disseminated results through international conferences, contributing to the broader body of research on UAS safety and cybersecurity. Students worked on their Bachelor's, Master's, and PhD theses on this innovative project, and ADACORSA results were incorporated into courses.