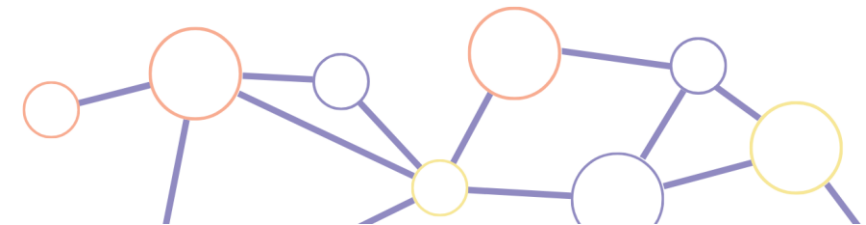# COLLARIS

**COLLaborative network on unmanned AeRIal Systems (UAS)
and their applications in the field of disaster response**

D4.1A – OVERVIEW OF CURRENTLY USED AND POSSIBLE TECHNICAL SOLUTIONS FOR DATA ANALYSIS AND DATA SHARING, INCLUDING COMMON PRACTICES: ASSESSMENT AND RECOMMENDATIONS FOR FUTURE USE.

WP4 – Solutions for data analysis and data sharing and auxiliary support systems

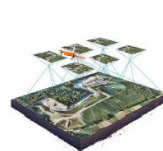### Initial Deliverable Report Preview

KIOS Research and Innovation Center of Excellence (KIOS CoE),
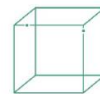University of Cyprus (UCY)
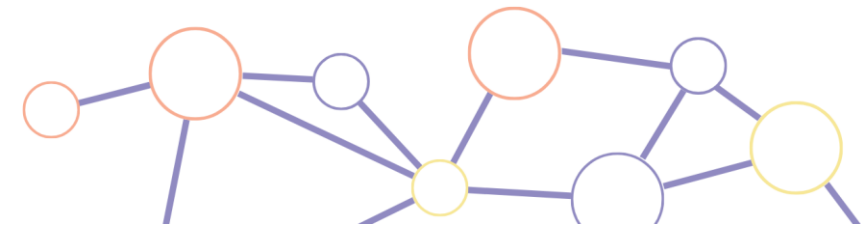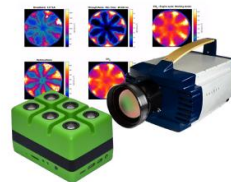
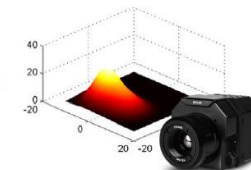# UAS Adaptive Data Collection Capabilities

Camera
Conventional RGB Images

Thermal
Relative Temperature Data

Multispectral
Broad Spectral Data (between 3-5 bands)

RadioMetric
Thermal and Radiometric data

Lidar
Elevation and structural data
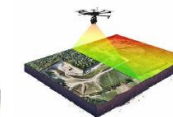
CBRNE
Multi-Gas detection data

USER NEEDS

Flame height
Surface size

Weather
Fire
Temperature
Spread rate
Vegetation type

Citizens
Buidlings
Road accessibility
Teams and means

Water height
Flooded surface

Weather forecast
Rainfall
Water speed
Real time flood discharge

Citizens
Buidlings
Road accessibility
Teams and means
Industrial/Sensitive area
Topographic drainage basin
Hydrographic network

Surface size

Weather forecast
Estimated population density
Structural assessment

Citizens
Buidlings
Road accessibility
Teams and means

UAS data analysis

- UAS data analysis involves **analyzing** and **interpreting** data collected by UAS from a range of **onboard sensors** to extract meaningful information and derive actionable insights.

Disaster response and emergency management

- real-time situational awareness
- damage assessment
- identify areas in need of assistance

UAS data analysis - Key Steps

- The UAS data analysis process typically involves the following key steps to extract meaningful insights from the collected data:

Data Collection → Data Preprocessing → Data Integration → Data Analysis → Validation and Quality Control → Interpretation and Visualization

UAS data analysis - Solutions Overview

Image Processing and Computer Vision

- Image Enhancement
- Image Stitching
- Feature Extraction
- Visual Odometry

Photogrammetry

- Dense Point Cloud Generation
- Surface Reconstruction
- Orthomosaic Generation
- Measurement and Analysis

LiDAR Data Analysis

- Digital Elevation Model (DEM)
- 3D Feature Extraction
- Building Reconstruction
- Vegetation Analysis
- Change Detection

Data Fusion

- Enhanced Data Representation
- Improved Accuracy and Reliability
- Feature Extraction

Machine Learning and Artificial Intelligence

- Object Detection and Recognition
- Image Classification and Segmentation
- Predictive Analytics

Real-Time Analytics

- Data Streaming and Processing
- Real-Time Object Detection
- Anomaly Detection and Alerts
- Adaptive Flight Path
- Data Reduction and Transmission

Geographic Information Systems (GIS)

Image Processing and Computer Vision

- ## Image Stitching

  - merge multiple UAS images that overlap

  - creating a seamless and continuous larger image
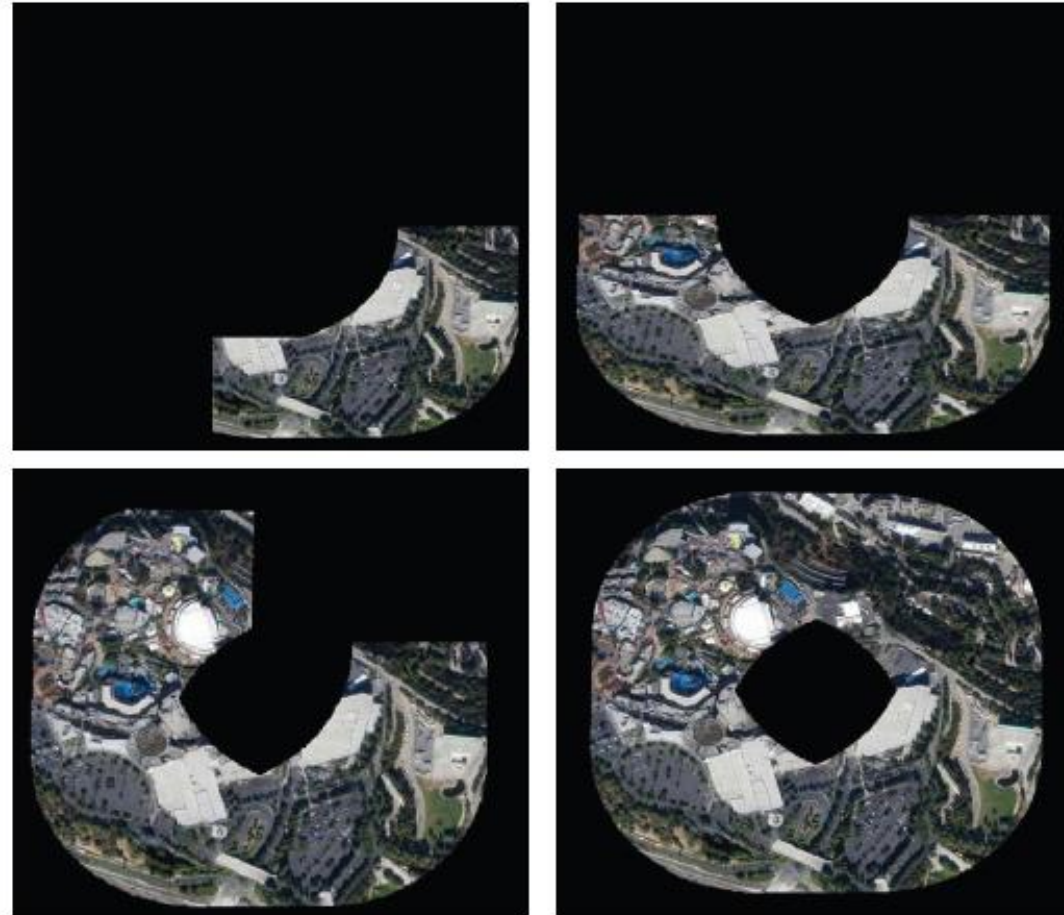
Photogrammetry

- Surface Reconstruction
  - representing the terrain or object surfaces with accurate spatial information

LiDAR Data Analysis

- Digital Elevation Model (DEM) Generation
  - represents the bare Earth surface without any above-ground objects
  - Very useful for terrain modeling, landform analysis, slope determination, and land cover classification
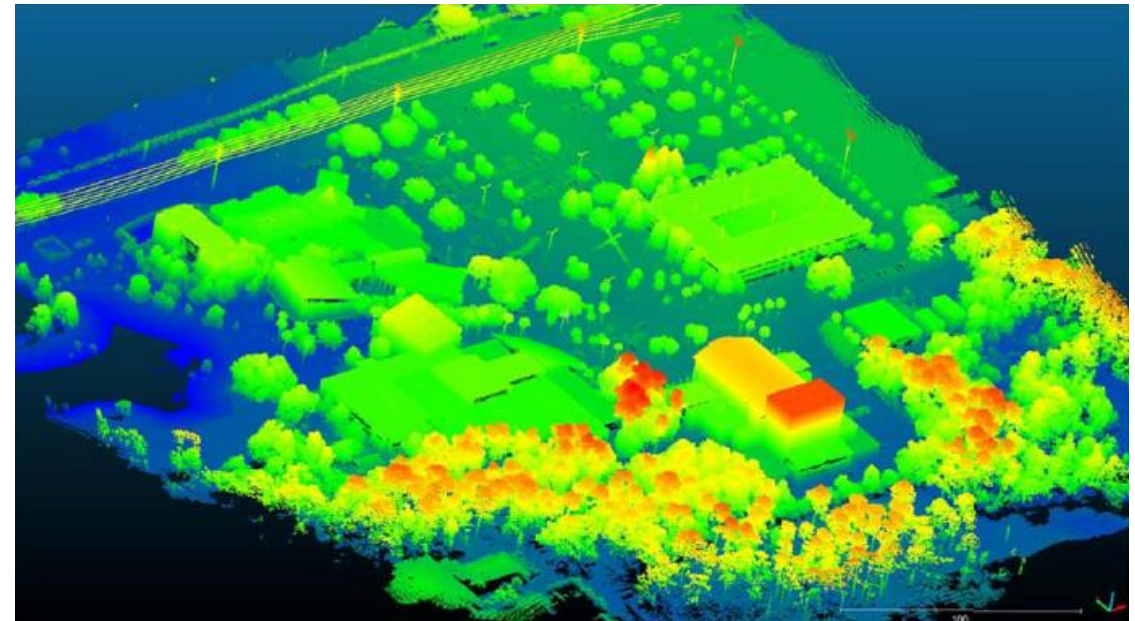
Data Fusion

- Enhanced Data Representation
  - creates comprehensive and enriched datasets from multiple sensors
  - colorized point clouds or textured 3D models

Machine Learning and Artificial Intelligence

- Object Detection and Recognition
  - can locate and identify specific objects, such as people, buildings, vehicles, etc., within the UAS capture images

- Image Classification and Segmentation
  - assign predefined labels or classes to UAS images based on their visual characteristics
  - mark different regions or objects within UAS images
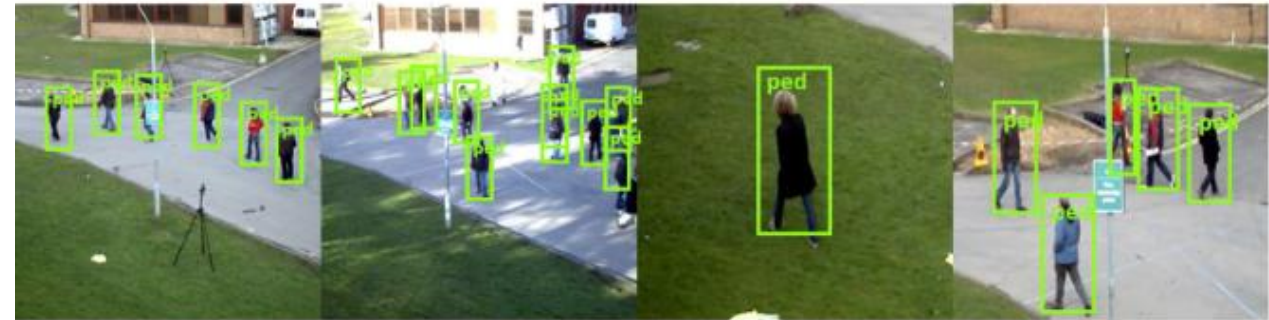
UAS data analysis - Common Best Practices

- Common best practices aim to ensure that the process of UAS data analysis is accurate, consistent, and reliable, while also promoting quality assurance, reproducibility, data interoperability, efficiency, safety, regulatory compliance, and ethical considerations.

UAS data analysis Common Best Practices

- Define clear objectives
- Plan data collection
- Use quality sensors
- Collect sufficient Ground Control Points
- Ensure Sufficient Overlap
- Maintain Data Integrity
- Pre-process and Clean Data
- Employ Robust Data Analysis based on objectives
- Validate and Cross-Check Results
- Document and Communicate Results
- Regularly Update Skills and Knowledge

UAS data sharing

- UAS data sharing involves **transferring, distributing, or providing access** to UAS collected data to individuals, organizations, or systems facilitating **collaboration, analysis, decision-making**, and further value creation from the collected information.

- Forms of UAS data sharing:
  - raw data files
  - processed datasets
  - derived products
    - Maps
    - 3D models
    - analytical reports

UAS data sharing process

Data Capture

Data Processing and Analysis

Data Preparation

Data Sharing Method Selection

Data Access Control

Data Transfer

Data Management

Data Retention and Privacy
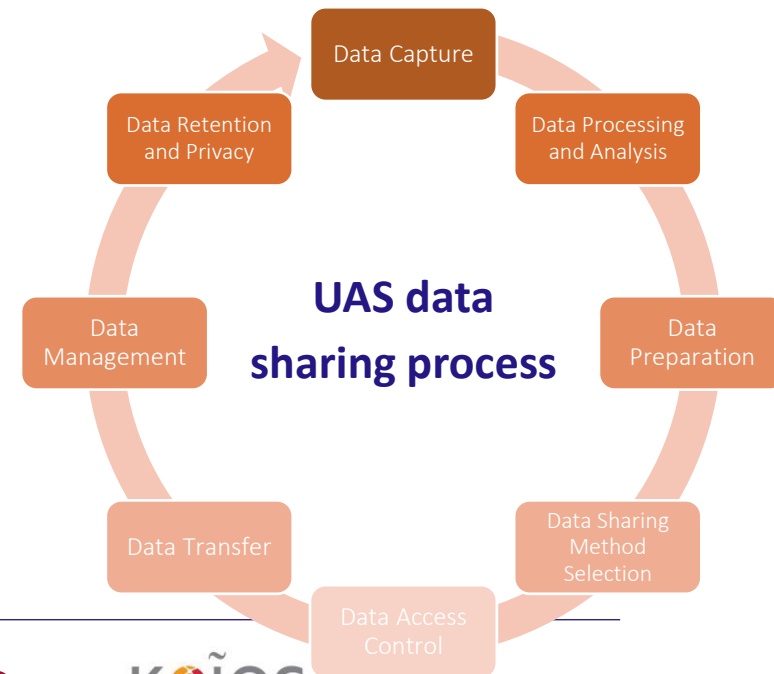
UAS data sharing solutions

Cloud-based Platforms

Application Programming Interfaces (APIs)

Geospatial Data Infrastructure (GDI)

Distributed Ledger Technologies (DLT)

Collaborative Platforms

Real-time Streaming and Telemetry

Edge Computing

Geospatial Intelligence (GEOINT) Frameworks

Open Data Initiatives

Interoperability Standards

Privacy-Preserving Techniques
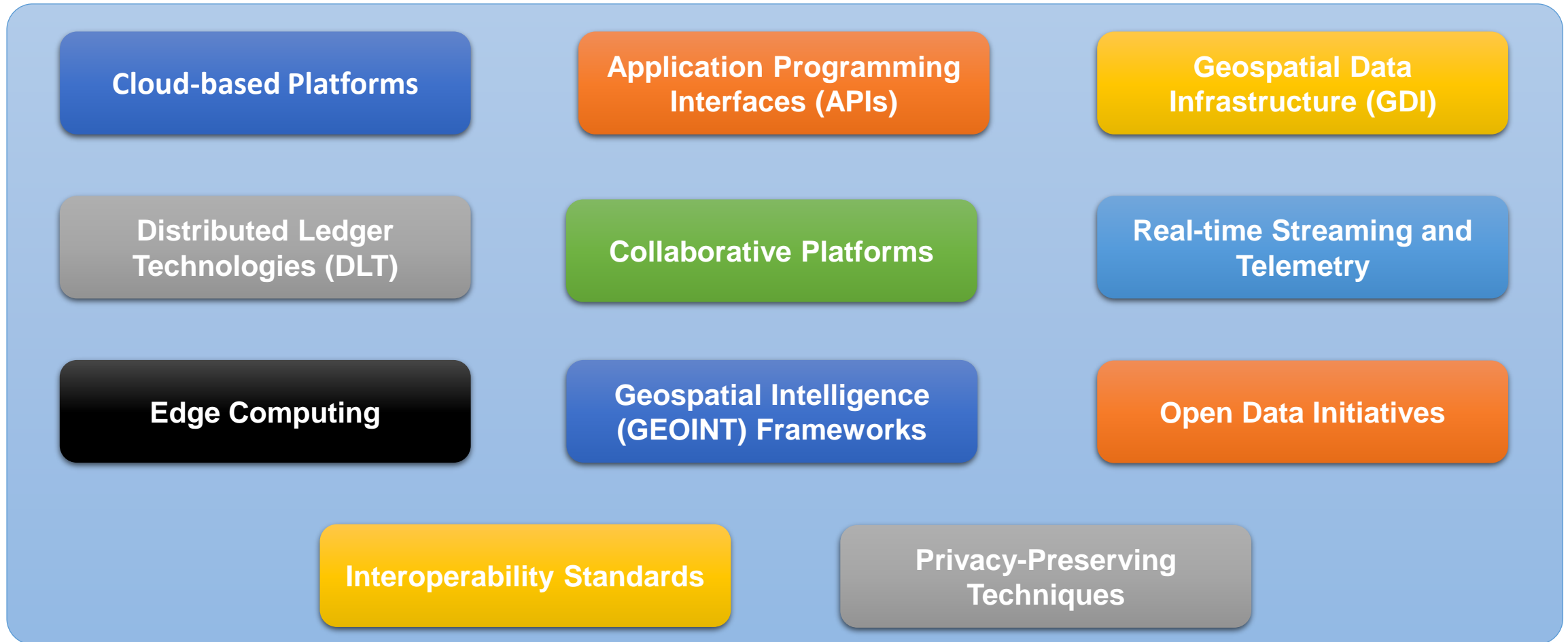
UAS data sharing Common Best Practices

Data Privacy and Security	Consent and Legal Compliance	Anonymization and Aggregation
Data Quality Assurance	Metadata and Documentation	Data Standards and Interoperability
Data Sharing Agreements and Contracts	Collaborative Platforms and Workflows	Data Retention and Data Lifecycle Management

Future Recommendations

- Standardized data formats and metadata for UAS data to facilitate data sharing and interoperability.

- Development of collaborative and UAS-specific data sharing platforms to promote seamless sharing and exchange among stakeholders

- Secure and user-friendly interfaces for UAS data to foster collaboration and broader utilization

- Further integration of machine learning and computer vision algorithms to automate data processing, object detection and classification tasks, thus accelerating the analysis process and extracting deeper insights from UAS data.

Conclusion

- UAS have witnessed widespread adoption and utilization.
- The final report will provide state-of-the-art knowledge on:
  - UAS data analysis and sharing solutions
  - Common best practices
  - Available software packages for UAS data analysis and sharing
  - Testing of available solutions
  - Future recommendations

Stay in touch!

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