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# UAV LiDAR and GNSS Surveys for High-Accuracy Spatial Data Acquisition Case Studies from Croatia and Bosnia and Herzegovina

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**Abstract:**

The acquisition of high-accuracy spatial data is essential for geodesy, civil engineering, cadastre, and environmental monitoring. This paper presents the integration of UAV-based LiDAR mapping and GNSS RTK/PPK positioning as a methodological framework for ensuring centimeter-level precision in national and regional spatial data infrastructures.

Surveys were performed in Croatia (Donja Višnjica, Gornje Jesenje, Jakopovec, Kapelščak, Laz Bistrički, Strmec) using the CROPOS GNSS network within the official HTRS96/TM coordinate system, and in Bosnia and Herzegovina (Jezerac well, Goranci – Mostar) using the FBiHPOS network within the official MGI 1901 / Balkans zone 6 system. These dual frameworks emphasize both the opportunities and challenges of cross-border geospatial interoperability (Idrizi et al., 2018).

A DJI Matrice 350 RTK UAV equipped with a DJI Zenmuse L2 LiDAR sensor and supported by an Emlid Reach RS2 GNSS receiver enabled surveys with centimeter-level accuracy (RMSE: X = 0.006 m; Y = 0.005 m; Z = 0.007 m). Data were processed in DJI Terra and Lidar360, producing dense point clouds (>240 pts/m²), high-resolution orthophotos (~2–3 cm GSD), and DEM/DSM products.

Results highlight that UAV-LiDAR surveys integrated with national GNSS infrastructures not only ensure compatibility with CROPOS and FBiHPOS, but also strengthen interoperability with European systems such as ETRS89 (Idrizi, 2021). This contributes to sustainable, harmonized spatial data infrastructures supporting scientific research, engineering applications, and long-term monitoring. Results are seen in Table 1, and a comparison of DEM and DSM generated from UAV-LiDAR surveys is seen in Figure 1.

Table 1. Summary of UAV-LiDAR Survey Parameters

| **Parameter** | **Dataset** | **Resolution/scale** |
|---|---|---|
| UAV platform | DJI Matrice 350 RTK | DJI Matrice 350 RTK |
| LiDAR sensor | DJI Zenmuse L2 | DJI Zenmuse L2 |
| GNSS corrections | CROPOS (RTK/PPK) | FBiHPOS (RTK) |
| Coordinate system | HTRS96/TM (EPSG:3765) | MGI 1901 / Balkans zone 6 (Gauss-Krüger) (EPSG:3908 or EPSG:8678) |
| Point cloud density | ~240 pts/m² | ~247 pts/m² |
| Horizontal accuracy (RMSE) | 0.007 m | 0.006 m |
| Vertical accuracy (RMSE) | 0.014 m | 0.007 m |

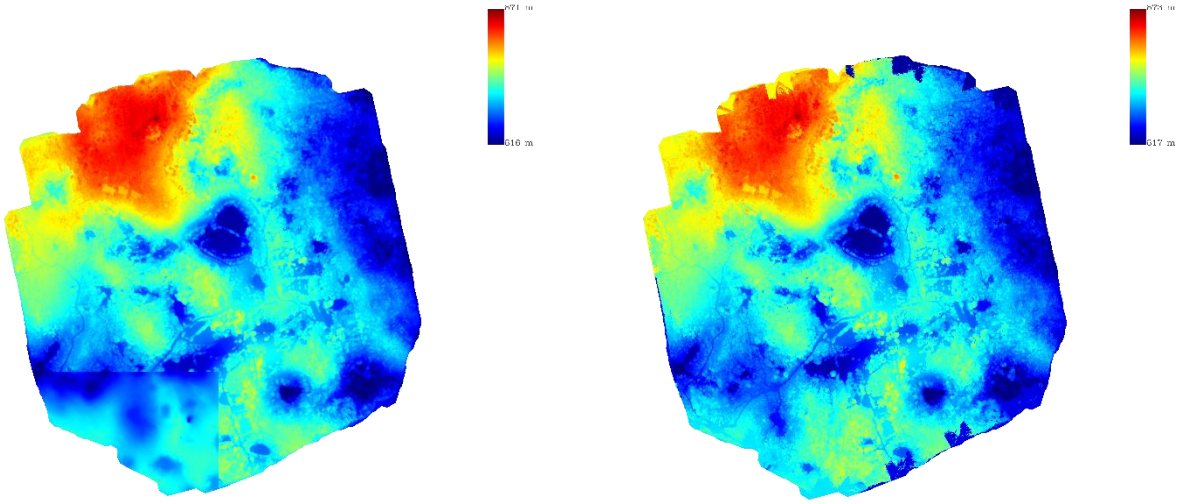

Figure 1. Comparison of DEM (left) and DSM (right) generated from UAV-LiDAR survey

## References

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