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PROBLEM STATEMENT AND REQUIREMENTS

Small UAVs are widely deployed for several mission tasks

Electronic warfare (EW) often disrupts mission capabilities and might cause UAV loss

DIFLY
TIDE Hackathon TEAM

PROBLEM STATEMENT AND REQUIREMENTS

Nominal conditions (link, GPS) allow execution of several missions: ISR, ISTAR, Environmental Digitalization, UXO map, etc

- Link loss can be coped by UA autonomy (**on board** solution wanted).
- Inertial navigation is insufficient to deal with GPS spoofing/jamming.
- **Visual based** navigation augmentation wanted for RTH.

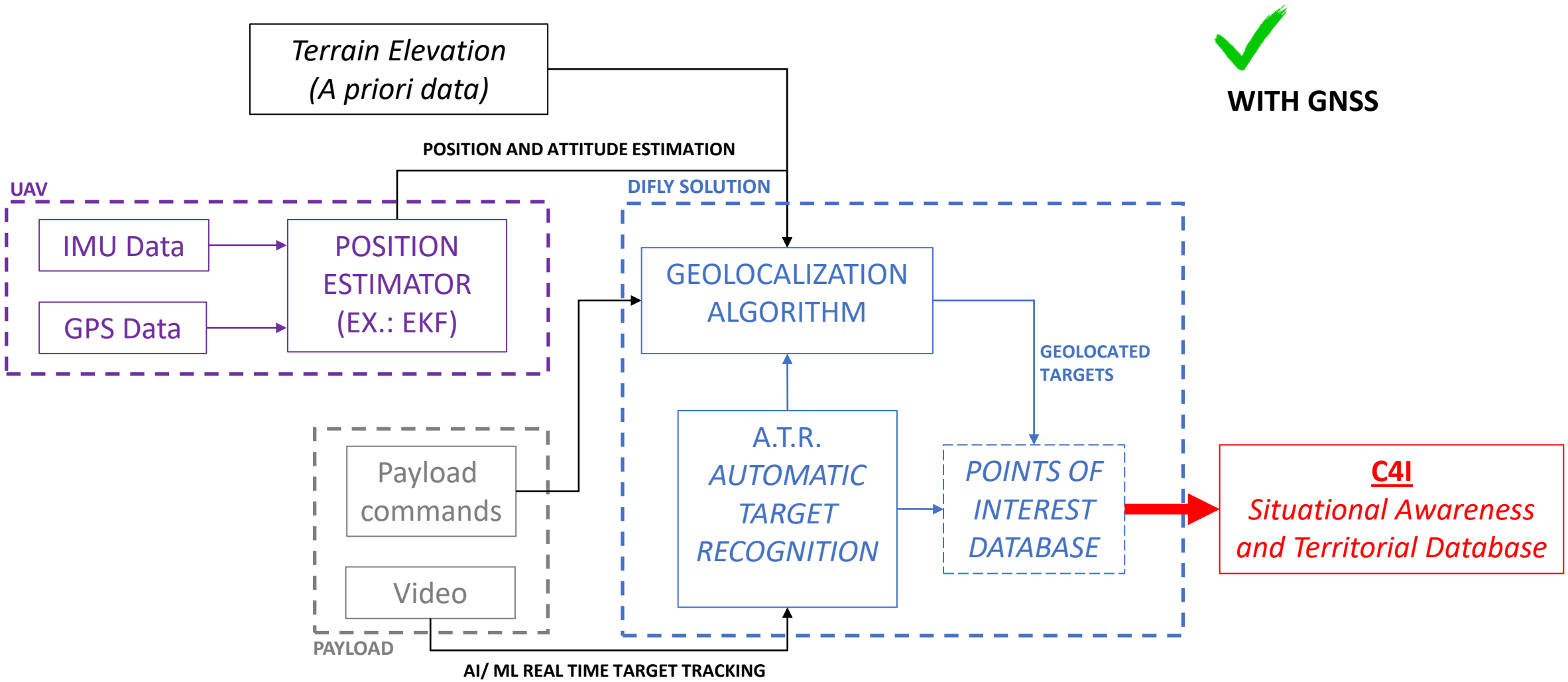
DIFLY
TIDE Hackathon TEAM

WHY DIFLY TIDE HACKATHON 2023

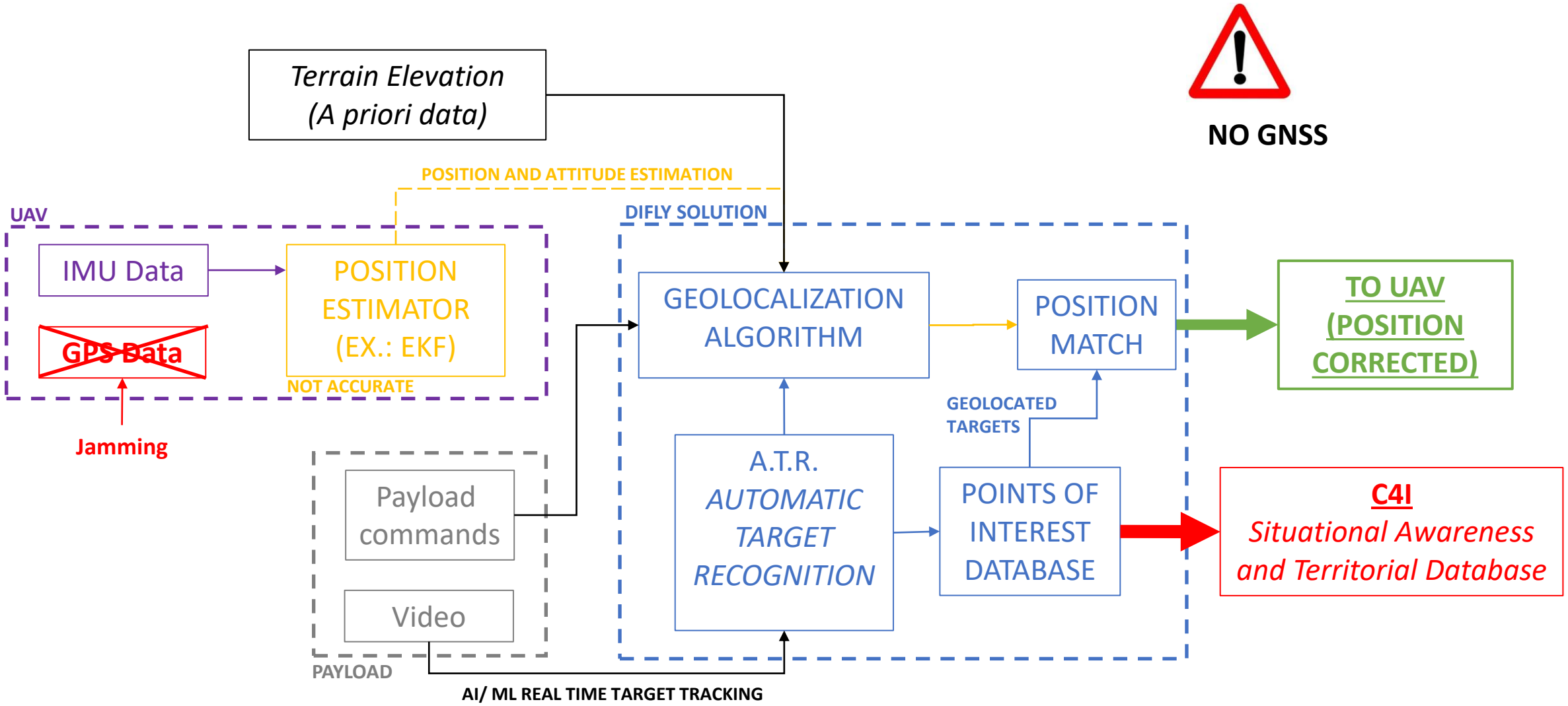
TIDE hackathon 2023 solution should prove improvement of position estimation in GPS denied environment using visual navigation

DIFLY wants to bring its experience and its innovative approach to contribute to technological development for NATO

SOLUTION ARCHITECTURE – WITH GNSS



SOLUTION ARCHITECTURE – LOST GNSS



Problem statement and requirements (2 phases).

WITH GNSS

NO GNSS

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Small UAVs are widely deployed for several mission tasks	Electronic warfare (EW) often disrupts mission capabilities and might cause UAV loss
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Difly team approach to TIDE hackathon 2023 (ConOps)

WITH GNSS

NO GNSS

Difly team approach to TIDE hackathon 2023 (ConOps)	
Difly team is specialized in aerial missions of terrain digitalization, automatic target recognition (ATR), object classification (DRI via AI/ML), UXO detection, surface and subsoil …… with proper sensors and GPS	TIDE hackathon 2023 solution should prove improvement of position estimation with GPS denied using visual navigation
Field information is built during the nominal condition phase: situational awareness from no (or minimal) a-priori information. **A database is built and stored: valuable mission output, it can also support future missions (improve a-priori knowledge), other units (data dissemination and interoperability).**	Self-generated situation awareness and database is used as navigation aid in GPS denied phase: ATR process carries on as in nominal mode; Information storage is stopped (geolocalization geopardized by position accuracy); Crosscheck of current ATR-location with database provides positioning aid (innovation/error).

Algorithm and architecture

WITH GNSS

NO GNSS

Algorithm and architecture	
Input: video + telemetry	Input: video + telemetry* + PoI database
Actions: ATR detect-recognize-classify-georeference points of interest (PoI) + information condensation and storage (database)	Actions: ATR (continues) + crosscheck with PoI database and PoIs shift determination (location error)
Output: database of PoI with absolute coordinates	Output: position correction suggested as augmented absolute positioning (virtual GNSS from visual navigation)
Out of scope (to date): UAV&PL commands (search path and geopointing)	Out of scope (to date): use the “innovation” information to correct UAV position estimation, UAV control actions to correct trajectory (this is flight safety critical and vehicle specific)

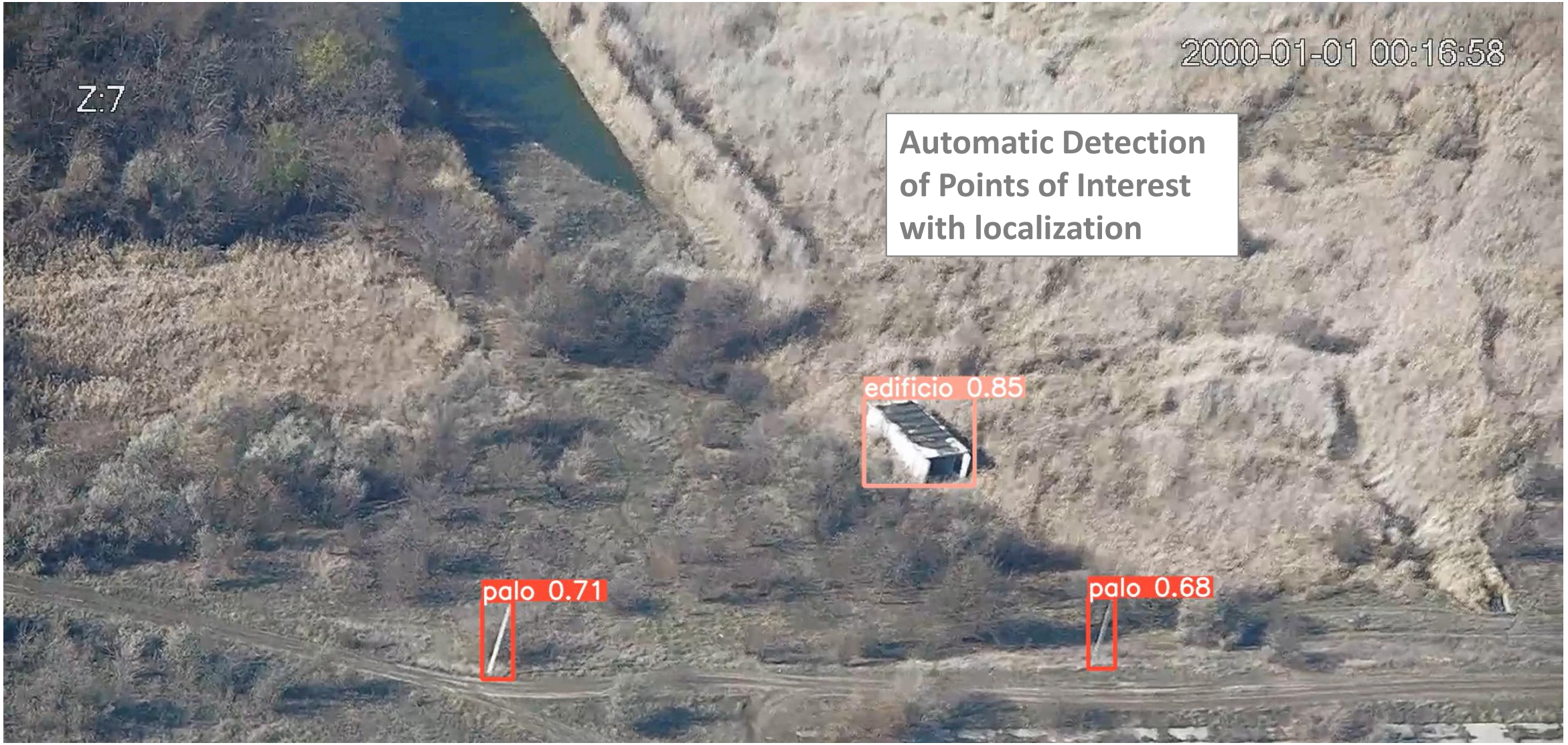
Proof of concept representativeness

WITH GNSS

NO GNSS

Real scenario solution versus hackathon demo scenario	
solution: fully representative of real time on- board processed algorithm	solution: fully representative algorithm
condition: fully representative concept, modules interoperability and interface to be improved, TRL to be improved	condition: Artificial position data should be created to simulate expected trajectory (desired path + position drift) and injected in the algorithm. Real telemetry data (GPS) to be used as actual trajectory. The algorithm is expected to suggest a correction from artificially injected position to the actual telemetry data.
use: only integration and performance improvements needed	use: integration with systems and validation of the solution needed
Future work: general improvements of the PoC	Future work: wayback (RTL) path planning optimized to keep within explored regions (fly by PoI); PL pointing to search expected PoIs; validation of GNSS denied navigation to allow continuing mission “normal operations” in GNSS denied (waypoint navigation, autonomous ISR, PoIs database improvement) limited to explored regions; GNSS spoofing detection

Samples of Automatic Target Recognition



Automatic Target Recognition

Automatic Detection of Points of Interest

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