BLUESLEMON
BT Beacon and Unmanned Aerial System technologies for Landslide Monitoring

GRUPPO FOS soluzioni ad alta tecnologia

MAVTech Micro Aerial Vehicles Technology

eurac research

A novel application of Unmanned Aerial Systems (UASs) in alpine environment for monitoring gravity-driven natural hazards: BLUESLEMON project

Alex Bojeri[1,2], Giovanni Giannotta[3], Christian Kofler[6], Erika Mai[2,4], Sebastian Mayrguendter[5], Gabriele Scarton[3], Stefano Seppi[5], Stefan Steger[6], and Fulvia Quagliotti[2,4]

[1]Università degli Studi di Trento, Trento, Italy (alex.bojeri@studenti.unitn.it)

[2]MAVTech S.r.l., Bolzano, Italy (alex.bojeri@mavtech.eu)

[3]Gruppo FOS S.p.a., Bolzano, Italy (giovanni.giannotta@fos.it)

[4]Politecnico di Torino, Torino, Italy (fulvia.quagliotti@formerfaculty.polito.it)

[5]NOI Techpark Südtirol/Alto Adige, Bolzano, Italy (s.mayrguendter@noi.bz.it)

[6]Eurac Research, Institute for Earth Observation, Bolzano, Italy (Christian.Kofler@eurac.edu)

Online, 08 May 2020 - EGU Sharing Geoscience Online 2020

Project Partners: FOS S.p.A.

GRUPPO FOS
soluzioni ad alta tecnologia

FOS Group is an innovative technological industry that promotes the Italian polytechnic culture with strong local roots and a broad international perspective. It offers itself to the market with operating companies focused on vertical technological skills that operate in an integrated manner and develop with the presence in leading international Research Centres and important technological districts. The Group has been operating for over 20 years in the Information and Communication Technology sector, integrating its expertise in the fields of Automation, Telecommunications and Engineering.

FOS S.p.A. is the lead partner of the project.

Project Partners: MAVTech S.r.l.

MAVTech s.r.l. was founded as a spin-off company of Politecnico di Torino (2005-2014), currently also located in Bolzano/Bozen as a Technology Company of NOI Techpark Südtirol/Alto Adige.

The main focus of MAVTech s.r.l. is the prototyping and production of Remotely Piloted Aircraft System (RPAS) with competitive performance and costs (including customer support and end-user training) resulting from the development of projects based on the transfer of new aerospace technologies from the research field to the operational and industrial sector.

MAVTech S.r.l. is the technology partner of the project.

Project Partners: Eurac Research

Eurac Research was founded in 1992 as an association under private law with staff undertaking research in the areas of Language and Law, Minorities and Autonomous Regions as well as the Alpine Environment. The centre gradually expanded its activities into new areas, attracted scientists from all over the world and introduced new structures. Today, almost 400 scientists from over 25 countries work here.

Eurac research is the research partner of the project.

Project Supporters

The development of the project is cofounded by provincial funds (Südtirol P.Law 14 / 2006) as Cooperation Project n. 006/2018.

TECHPARK SÜDTIROL / ALTO ADIGE

NOI Techpark Südtirol / Alto Adige

BEACON SÜDTIROL·ALTO ADIGE

The Beacon Südtirol – Alto Adige

AUTONOME PROVINZ BOZEN - SÜDTIROL
PROVINCIA AUTONOMA DI BOLZANO - ALTO ADIGE
PROVINZIA AUTONOMA DE BULSAN - SÜDTIROL

Provincia Autonoma di Bolzano – Alto Adige

BLUES DEMON
BT Beacon and Unmanned Aerial System technologies for Landslide Monitoring

GRUPPO FOS soluzioni ad alta tecnologia

MAV Tech

eurac research

BLUESLEMON Project Overview

OBJECTIVES

The project aims to…

I. …build upon **innovative technologies** at the highest level of the State of the Art

II. …**integrate** these technologies to create an innovative natural hazard **monitoring system** for diverse environmental conditions (e.g. alpine environment)

III. …enable field information collection, in order to support provincial services by providing accurate field measurements.

BLUESLEMON Project Overview

Low-cost automatic system for monitoring landslide surface displacement through the integration of Bluetooth (BT) Beacons localization and Unmanned Aerial Systems (UAS) also named Remotely Piloted Aircraft System (RPAS) technologies.

Technologies:

- Wireless Power Transfers, BT Beacons
- Radio-frequency identification (RFID)
- Unmanned Aerial Systems (UAS)

Implementation time: 36 Month

BLUESLEMON Project Peculiarities

- Implementation of a pervasive **monitoring system** of landslide zones
- **Low environmental impact** components in situ: no cables and small size components
- Increasing the **monitoring capacity** of landslide areas (slow moving landslides, wooded areas, rock faces,…)
- Increasing **operator safety** in high risk locations
- **Easy** manual **installation** with different types of supports and possible configurations
- Obtain **timely information** on the movement rates in the medium and short term on specific surface movement

BLUESLEMON Project Peculiarities

- Widespread **availability of information** throughout the intervention chain
- Use of **low-cost technology** to enable widespread monitoring with limited resources
- Implementation of an **information transmission network** that provides timely information to operators, to make decisions using standard terminals
- Use of Internet Of Things and Fog Computing paradigms for **terminals management** in situ
- Multi-role and multi-objective **UAS** able to manage the detection nodes on the surfaces at risk
- RPAS able to **operate in extreme** climatic and environmental **conditions**

Potential Test Case

The Corvara earth slide-earth flow (1)

Characteristics

- Elevation: from 1500 m to 2150 m
- Length: 3.5 km (1.7 km²)
- Rotational slide (upper part); flow (lower part)
- Active since at least 10,000 cal BP (C14 dating)

Why suitable to test the flexibility of the system?

- Varying movement rates (from several metres to centrimetes a year)
- Varying topography (from steep to flat) with open and forested areas
- In-situ monitoring system in place for validation (next slide)

Potential Test Case

The Corvara earth slide-earth flow (2)

Characteristics

- Elevation: from 1500 m to 2150 m
- Length: 3.5 km (1.7 km²)
- Rotational slide (upper part); flow (lower part)
- Active since at least 10,000 cal BP (C14 dating)

Corvara monitoring system:

- Long time-series of dGPS measurements (since 2013)
- 3 permanently installed dGNSS stations
- Regular measuring campaings conducted
- Additional data: LiDAR, SAR, 3D photogrammetry

BLUESEMON BT Beacon and Unmanned Aerial System technologies for Landslide Monitoring | GRUPPO FOS soluzioni ad alta tecnologia | MAV Tech | eurac research

UAS and Beacon Reader

Unmanned Aerial System (UAS)

- Accurate localization and positioning system (GPS RTK)
- Detection and control of ground nodes
- Endurance and stability performances allow to detect ground nodes in a unique flight mission
- Autonomous missions defined by waypoints set previously
- Reconfigurable platform for different payloads

BLUESEMON
BT Beacon and Unmanned Aerial System technologies for Landslide Monitoring

GRUPPO FOS soluzioni ad alta tecnologia | MAV Tech | eurac research

UAS and Beacon Reader

Beacon System

- Accurate distribution on the landslide
- Reference beacon
- Endurance and stability performances:
  - up to 7 years of battery endurance;
- No active maintenance
- Easily reconfigurable distribution

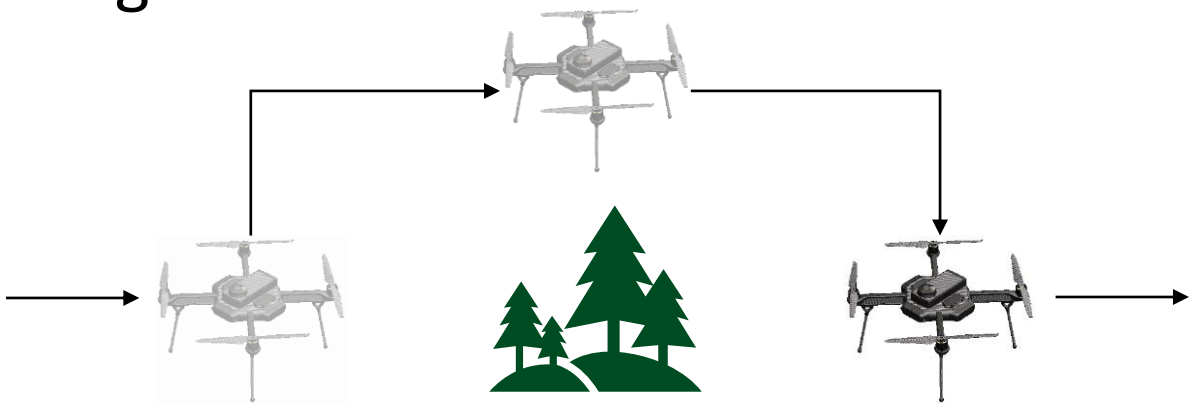
Systems Peculiarities

Ground Sensors Technology:

- Identification of low-power-consumption and high-precision Bluetooth devices

Unmanned Aerial System:

- Capability to work even at a limit of feasibility considered for an Alpine scenario (e.g. -20 °C at 2500 m asl)
- Management of obstacle-detection sensors and collision-avoidance algorithms



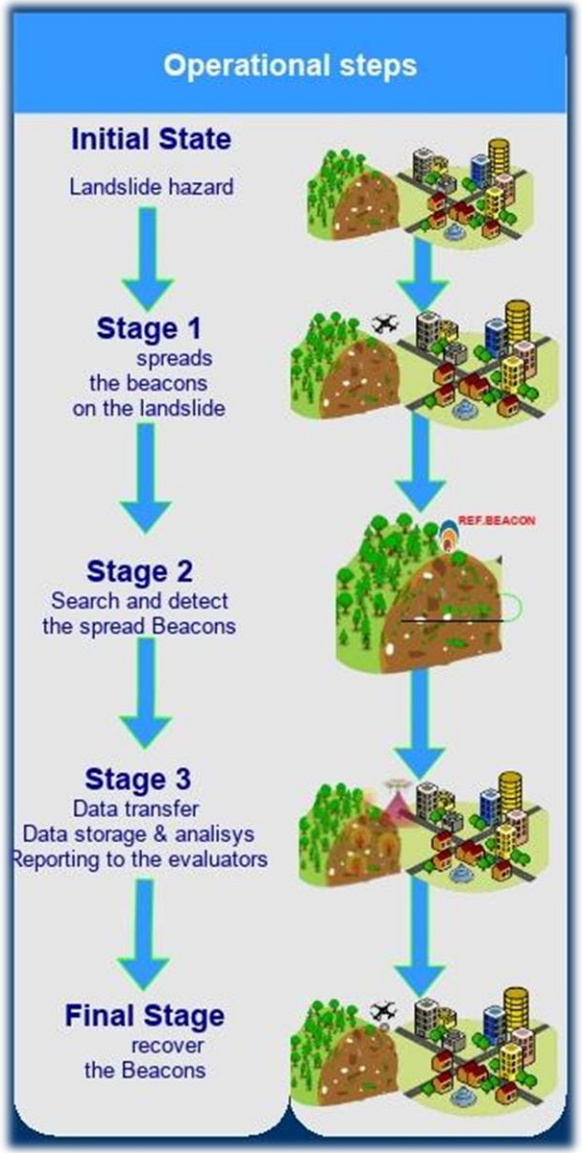
Operational Steps

Stage 1

Beacons will be distributed over the whole landslide front.

Stage 2

UAS will starts search-and-detect phase to individuate beacons and retrive informations about their positions.



Operational Steps

Stage 3

Beacon's positioning data will be transferred to ground through the UAS communication system. Subsequently, they will be stored and analysed.

Stage 4

Beacons will be recovered from the whole landslide front.

Expected Challenges and Future Applications

- Exceed State of the art technologies:
  - Obtaining a single **integrated system**
  - Obtaining a **low-cost** system
  - Obtaining a system adaptable for the inspection of movements related to **different types of gravity-driven natural hazards** (e.g. slow moving landslides; opening of cracks in rock walls)
  - Avoiding **risky in situ operations** through the use of an autonomous system

- Considerable added value elements:
  - Future **reconfigurations** of the developed system in order to extend its use
  - Other fields of application, for example **search and rescue** operations in dangerous conditions or **glaciers shift monitoring**.

BLUES BEAMON
BT Beacon and Unmanned Aerial System technologies for Landslide Monitoring

GRUPPO FOS
soluzioni ad alta tecnologia

MAV Tech
Micro Aerial Vehicles Technology

eurac research

THANK YOU FOR YOUR ATTENTION!

EGU