GEOTEQ

Sensor Systems and Technologies for scalable monitoring of snow avalanches and other geophysical processes

Programm / Ausschreibung	Spin-off Fellowship, Spin-off Fellowship, 2. AS Spin Off Fellowship 2022-2027	**Status**	laufend
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Projektbeschreibung

Gemäß dem Strategieplan "Horizont Europa" (2021-2024) der Europäischen Kommission besteht die Notwendigkeit, Europa umweltfreundlicher und digitaler zu gestalten. Dies erfordert die Umgestaltung der Mobilitäts-, Energie-, Bau- und Produktionssysteme, die Wiederherstellung von Ökosystemen und biologischer Vielfalt, die nachhaltige Bewirtschaftung natürlicher Ressourcen sowie die Vorbereitung und Reaktion auf Naturkatastrophen. Ein gemeinsamer Faktor bei all diesen Zielen ist die Notwendigkeit einer verbesserten Überwachung, eines tieferen Verständnisses und präziseren Vorhersagen geophysikalischer Parameter und Prozesse.

Beispielsweise benötigen autonome Fahrzeuge Wetterdaten zur Entscheidungsfindung, Drohnen benötigen Winddaten für effiziente Flugplanung, die Erzeugung umweltfreundlicher Energie erfordert die Überwachung hydrologischer Prozesse, und die Vorhersage von Extremwetter und Naturkatastrophen ist entscheidend, um Menschenleben zu schützen. Daher wird die Suche nach kosteneffizienten Möglichkeiten zur besseren Messung, Überwachung und Verständnis geophysikalischer Parameter und Prozesse immer wichtiger.

Die bisherigen Sensortechnologien für diese Zwecke sind in der Regel teuer und unflexibel, basieren auf proprietärer Hardware und Software und erfordern Expertenwissen. Neue Technologien wie Solid State-Lidar, 3D-Radar, KI und Open-Source-Datenpipelines haben bisher in diesem Markt wenig Einzug gehalten. Daher ist die Schaffung einer gut koordinierten Lösung auf Basis von Expertenwissen in den relevanten Bereichen entscheidend.

Das GEOTEQ-Team vereint das interne Know-how und eine umfangreiche Forschungsprojektlandschaft, um ein Unternehmen zu gründen, das kosteneffiziente Lösungen für die Messung und Überwachung geophysikalischer Parameter und Prozesse auf Basis modernster Technologien bietet. Das Team besteht aus Forschungseinrichtungen wie der Universität Graz, Virtual Vehicle Research und FH JOANNEUM, die auf Fachwissen in den Bereichen Geophysik, Fernerkundung, Elektronik, Maschinenbau, Softwareentwicklung und Wirtschaft zurückgreifen können.

Das Hauptziel besteht darin, ein kommerzielles Produkt für die Schnee- und Lawinenüberwachung zu entwickeln. Dieses

Produkt wird auf Lidar- und Radartechnologie sowie Fernerkundung im Automobilbereich setzen und von Open-Source-Software begleitet sein. In den österreichischen Alpen sind in den letzten 25 Jahren 587 Menschen bei Lawinenabgängen ums Leben gekommen, und die finanziellen Verluste durch Straßensperrungen und Schäden werden auf über eine Milliarde Euro geschätzt. Die derzeitige Lawinenerkennung basiert hauptsächlich auf Beobachtungen vor Ort, die jedoch oft unvollständig sind. Auf Grundlage von Ergebnissen aus FFG-Projekten (SnowAV_AT, RSnowAUT) und eines Spin-off-Lab der Universität Graz sollen kosteneffiziente Lösungen zur Überwachung der regionalen und lokalen Lawinenaktivität entwickelt werden, wobei das geistige Eigentum der Universität Graz gemäß der beigefügten Vereinbarung dem Unternehmen zur Verfügung gestellt wird.

Abstract

According to the EC's Horizon Europe strategic plan (2021-2024), Europe must become greener, more digital, transform its mobility, energy, construction, and production systems, restore ecosystems and biodiversity, manage sustainably of natural resources, and be prepared and responsive to natural disasters. All these goals have one common demand: They require a better monitoring, understanding, and prediction of geophysical parameters and processes. E.g., autonomous vehicles require weather parameters for decision making, drones require wind parameters for efficient path planning, green energy production requires monitoring of hydrological processes, extreme weathers and natural disasters need to be predicted and closely monitored to safe human lives. Finding cost-efficient ways to better measure, monitor and understand geophysical parameters and processes is therefore becoming increasingly important. Existing sensor technologies for geophysical parameters and processes typically require closed source commercial hardware and software, expert knowledge for installation, are not based on cutting-edge technology, and are too costly and inflexible for many use cases. E.g., a terrestrial laser scanner costs around 150k EUR, a weather station costs 5-10k EUR. Many recently emerging technologies, such as solid-state lidar, 3D radar, AI, and open-source data pipelines, have not yet found their way into this market, because novel, reliable solutions require a well-defined and coordinated setup based on expert knowledge in all relevant fields, including SENSOR hardware, PERCEPTION algorithms based on AI, DATA PIPELINES to include relevant third-party data, and modelling to create a DIGITAL TWIN for a deeper understanding and prediction of the processes.

The GEOTEQ team brings together all the relevant proprietary know-how and a corresponding research project landscape and establish the basis for a company that provides novel, cost-efficient solutions for measuring and monitoring geophysical parameters and processes based on cutting-edge technologies. The team is distributed over three research institutions and (University of Graz, Virtual Vehicle Research and FH JOANNEUM) and can use the knowhow and infrastructure of each institution. They have been working together for over 4 years and and have expertise in: geophysics, remote sensing, electronics, mechanical engineering, software development and business.

The main objective is to develop a commercial product for snow and avalanche monitoring based on automotive lidar and radar technology and remote sensing accompanied by open-source software that builds the first success story for the newly founded company and attracts customers and clients. In the last 25 years, 587 people lost their lives in snow avalanches in the Austrian Alps. The annual financial loss due to road closures and damages is estimated to be more than one billion EUR in Europe. Avalanche detection is currently mainly done during on-site observations. Avalanche activity observations are largely incomplete both on regional (several mountains) and local (individual slopes) scale. Based on the results from two FFG projects (SnowAV_AT, RSnowAUT) and a University of Graz Spin-off Lab, products for cost-efficient monitoring of both regional and local avalanche activities shall be developed. The intellectual property belongs to University of Graz and is

provided to the company, according to the enclosed agreement.

Endberichtkurzfassung

Snow avalanches are a serious natural hazard threatening roads, villages, and infrastructure in mountain regions. Knowing how snow accumulates and changes on a slope is critical for predicting avalanche risk, planning protective measures, and operating warning services. Yet continuous, automated snow monitoring at the required detail and scale has until now been too expensive or technically complex for most operators.

GEOTEQ developed an affordable, end-to-end sensor system for continuous automated snow and avalanche monitoring. The system is based on low-cost lidar sensors, which use laser pulses to measure the exact shape of a snow surface from a distance, continuously and in all weather conditions including at night. Raw sensor data is automatically processed and made available through a standard web interface (REST API), meaning any organisation can integrate live snow depth and change data directly into their own software, dashboards, or warning systems without specialist knowledge. The API is publicly documented at api.avalanchemonitoring.com/schema/swagger. A demonstration is available at lech.avalanchemonitoring.com, developed for Lech Bergbahnen AG. The general project website is at avalanchemonitoring.com.

The system was deployed and validated across two full winter seasons at installations in the Austrian Alps, in Longyearbyen on Svalbard in the high Arctic, and at the Austrian Polar Research Station. More than 300 GB of snow monitoring data were collected, forming a valuable scientific dataset. Results were presented at the EGU General Assembly 2025 and jointly with the Norwegian Public Roads Administration at the International Symposium on Mitigation Measures against Snow Avalanches in Iceland in 2025.

The project also demonstrated that automated regional avalanche detection from satellite radar data is feasible, and that ground-based sensor installations like those developed in GEOTEQ can serve as ground truth to continuously improve such detection systems. This combination opens the path toward a scalable, data-driven avalanche early warning service covering entire mountain regions.

The system was nominated for the Steirischer Innovationspreis in the category Digitalisierung (F&E-Institutionen). Relationships with key customers were established and a founding team with expertise in technology, remote sensing, hardware, and sales was assembled. The spin-off company is being actively prepared, pending seed funding.

Projektpartner

- Universität Graz