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Toward automatic avalanche detection with Distributed-Acoustic-Sensing leveraging telecommunication infrastructure

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Snow avalanches pose significant threats in alpine regions, leading to considerable human and economic losses. The ability to promptly identify the locations and timing of avalanche events is essential for effective prediction and risk mitigation. Conventional automatic avalanche detection systems typically rely on radars and/or seismo-acoustic sensors. While these systems operate successfully regardless of weather conditions, their coverage is often confined to a single slope or a small catchment (distances < 3 km).

In our study, we demonstrate the feasibility of detecting snow avalanches using Distributed Acoustic Sensing (DAS) through existing fiber-optic telecommunication cables. Our pilot experiment, conducted over the 2021/2022 winter, involved a 10km long fiber-optic dark cable running parallel to the Flüelapass road in the eastern Swiss Alps close to Davos. The DAS data reveal distinct evidence of numerous dry- and wet-snow avalanches, even when they do not reach the cable, as confirmed photographically. We show that avalanches can be distinguished from other signals (e.g., vehicle traffic) using a frequency-dependent STA/LTA attribute, enabling their detection with high spatiotemporal resolution. These findings pave the way for cost-effective and near-real-time avalanche monitoring over extensive distances, leveraging existing fiber-optic infrastructure.