

SNOW AVALANCHES: AUTOMATIC ACOUSTIC DETECTION FOR OPERATIONAL FORECASTING

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Avalanches remain a major hazard in alpine countries. Applied acoustics has recently come to the fore as useful tool for improving avalanche forecasting by supplying the means of automatically detecting, in continuous real time, avalanche activity over a mountain range. Such information, which is impossible to provide from manual observations alone, due to weather, lack of visibility at night, masking relief's, avalanche types, etc., is of major importance [1] to forecast systems - in particular for those using analogy-based reasoning models. To evaluate the feasibility of acoustic detection, a first set of measurements was carried out. The experimental system consisted of four outside weatherproofed microphones, respectively situated at the three tips and centre of a 50 m half-cross figure, and combined in such a way as to constitute an acoustic goniometer: the localisation and incident direction of sound waves - azimuth, elevation - were obtained from the calculated time-delays of sound waves on a triplet of microphones (the use of a fourth microphone was to double the measuring configuration of three microphones in order to give a rejection criteria by comparison of the results obtained simultaneously). The system enabled the infra sound emission from powder snow avalanches to be verified and characterised and demonstrated the possibility of using such signals to detect, localize and in some cases follow avalanches over areas extending up to several kilometres [2].

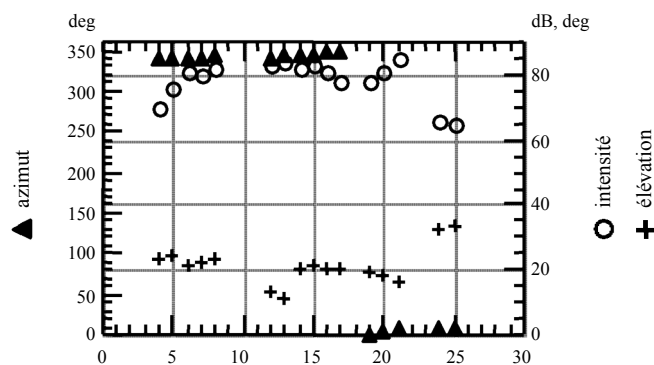


Figure 1: typical automatic localisation result (1 to 10 Hz range). It is now planned to develop a dedicated operational acoustic detection system and to interface it to a forecast system used in avalanche threatened zones.

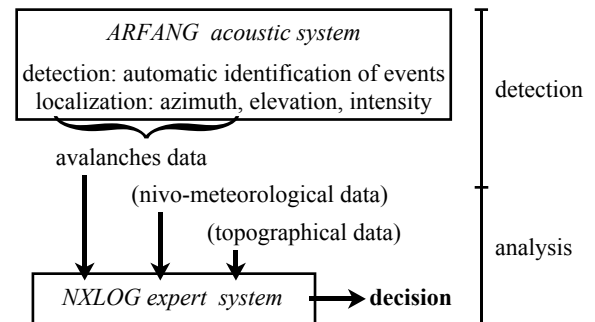


Figure 2: local forecasting of avalanche hazards

The development is planned in a 5-year project, the main tasks of which are the optimisation of sound pick up, automatic identification of events and overall validation of the system. A microphone prototype dedicated to infra sound and suitable for high mountain winter topographical and meteorological conditions has been built. Further measurements will adopt a new ground configuration still using four microphones but star-positioned and directly under the snow cover. Arfang is a common project between the Laboratory of Electromagnetism and Acoustics (LEMA) at EPFL and the Natural Hazards Section of the Canton du Valais, with the Defence Technology and Procurement Agency of Switzerland and the Federal Institute for Snow and Avalanche Research.

References

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