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Distributed acoustic sensing for seismic monitoring in challenging environments

Zack Spica[1], Takeshi Akuhara[2], Gregory Beroza[3], Biondo Biondi[3], William Ellsworth[3], Ariel Lellouch[3], Eileen Martin[4], Kiwamu Nishida[2], François Pétrélis[5], Mathieu Perton[6], Masanao Shinohara[2], Tomoaki Yamada[2], and Siyuan Yuan[3]

[1]Earth and Environmental Sciences, University of Michigan, Ann Arbor, USA
[2]Earthquake Research Institute, University of Tokyo, Tokyo, Japan
[3]Geophysics, Stanford university, Stanford, USA
[4]Department of Mathematics, Virginia Polytechnic Institute, USA
[5]Laboratoire de Physique Statistique, École Normale Supérieure, Paris, France
[6]Instituto de Ingeniería, Universidad Nacional Autónoma de México, Mexico

Our understanding of subsurface processes suffers from a profound observation bias: ground-motion sensors are rare, sparse, clustered on continents and not available where they are most needed. A new seismic recording technology called distributed acoustic sensing (DAS), can transform existing telecommunication fiber-optic cables into arrays of thousands of sensors, enabling meter-scale recording over tens of kilometers of linear fiber length. DAS works in high-pressure and high-temperature environments, enabling long-term recordings of seismic signals inside reservoirs, fault zones, near active volcanoes, in deep seas or in highly urbanized areas.

In this talk, we will introduce this laser-based technology and present three recent cases of study. The first experiment is in the city of Stanford, California, where DAS measurements are used to provide geotechnical information at a scale normally unattainable (i.e., for each building) with traditional geophone instrumentation. In the second study, we will show how downhole DAS passive recordings from the San Andreas Fault Observatory at Depth can be used for seismic velocity estimation. In the third research, we use DAS (in collaboration with Fujitec) to understand the ocean physics and infer seismic properties of the seafloor under a 100 km telecommunication cable.