Modeling envelopes of DAS records based on the single isotropic scattering model

*Hisashi Nakahara[1], Kentaro Emoto[1], Takeshi Nishimura[1]

1. Solid Earth Physics Laboratory, Department of Geophysics, Graduate School of Science, Tohoku University

Distributed Acoustic Sensing (DAS) techniques enable us to measure strain or strain rate along a fiber-optic cable with spatial resolutions of 10m or less. Therefore, it would be possible to use phase information of strain seismograms in seismic array analyses even in high frequencies. However, when coherences of strain seismograms beween neighbouring channels are lost, the seismic array analysis can not be applied. In such cases, analyses using seismogram envelopes would be helpful. As far as we know, envelopes of DAS strain seismograms (hereafter DAS envelopes) have not been modeled. In this study, we model DAS envelopes based on the single isotropic scattering model. We start from simple two-dimensional configurations. So far, envelopes of translation seismograms have been modeled based on the radiative transfer theory and have been utilized for studying seismic coda. We basically follow this approach but extend to strains. Under assumptions of polarization of P waves or S waves and the single isotropic scattering in two-dimensional media, we have succeeded in analytically formulating DAS envelopes. According to the formulation, the directional sensitivity of DAS has a strong effect on the amplitude of DAS envelopes especially for the direct P waves or S waves. But this sensitivity dies out with lapse time because coda waves are incident from various azimuthal angles. Therefore, among different channels having different cable orientations, DAS envelopes are expected to have large fluctuations around direct wave arrivals but similar amplitudes at later lapse times. We plan to compare our analytical DAS envelopes with DAS envelopes observed in Japan.

Keywords: Distributed Acoustic Sensing (DAS), envelope, scattering