Real-time correction of frequency-dependent site amplification factors in time domain: Introduction of phase delay for real-time prediction of duration of ground motion

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We propose a method for real-time prediction of duration of strong ground motion for earthquake early warning (EEW). Because the long duration of shaking is often observed on basin structure, prediction of duration is important in EEW in addition to the strength of shaking.

Although many of EEW system focus on rapid determination of source characteristics such as event hypocenter and magnitude, subject of EEW itself is the prediction of ground shaking, where hypocenter and magnitude are not necessarily required. Recently innovative methods have been proposed for the real-time prediction of ground motion without source characteristics, where current wavefield is estimated precisely using data assimilation, and then future wavefield is predicted based on physics of wave propagation (Hoshiba and Aoki, 2015; Kodera et al, 2018).

Site amplification is an important factor for ground motion as well as source characteristics and path factors, and the site amplification is frequency dependent. Because the frequency dependence should be corrected in real-time for EEW, it is preferable to correct the frequency dependence in time domain. The correction was proposed in Hoshiba (2013) by using IIR filter, in which amplitude characteristics were taken into account but phase was not fully taken because minimum phase system is assumed in the IIR filter. Because of it, it was not easy to reproduce the long duration of ground motion on basin structure. Recently a method to introduce the phase characteristics was discussed in Pilz and Parolai (2016) on minimum phase assumption.
In this presentation, we will propose a method to correct phase characteristics by changing the minimum phase IIR filter to mixed phase system. The introduction of the mixed phase makes it possible to reproduce the long duration of ground motion on basins, and leads to precise prediction of duration of shaking in EEW.

Keywords: Earthquake Early Warning, Site Amplification Factor, real-time, IIR Filter, Phase

