APPLICATION OF THE EEMD METHOD TO INVESTIGATE PORE PRESSURE BUILD-UPS IN A WAVE-FLUIDIZED SANDBED

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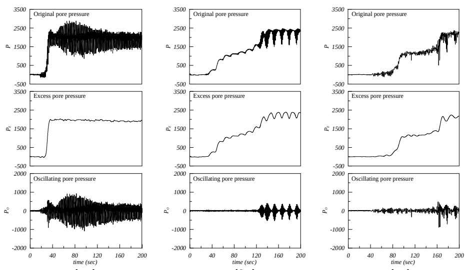
INTRODUCTION

A wave-fluidized response is defined as the pore pressure build-up (excess) approaches the soil's static stress at a given soil depth (Tzang and Ou, 2006). In the past, the linear moving average scheme (LMAS) is used to derive the excess components from temporal pore pressure records in a wave-fluidized sandbed. Although the LMAS is an effective method to derive the mean of pore pressure, it is essentially based on linear concept. Thus, it is unreasonable to apply it to analyze nonlinear or irregular wave-induced pore pressure build-ups. In order to obtain correct excess components of pore pressure, the Empirical Mode Decomposition (EMD) recently proposed by Huang et al. (1998) is considered a suitable technique to process pore pressure records. Since, the original EMD has a drawback on the frequent appearance of "mode mixing", the Ensemble EMD (EEMD, Wu and Huang, 2005) is instead adopted in this work.

RESULTS AND DISSCUSSIONS

For a monochromatic wave-induced fluidized response, typical pore pressure records at 0.3 m underneath the sandbed is displayed in the top of Figure 1(a). The intrinsic mode functions (IMFs) and the residue components derived by applying EEMD are shown in Figure 2. It is seen that the fourth component C_4 has the same frequency as waves while the IMF C_1 - C_3 are superharmonic components. The excess component of pore pressure as shown in the middle of Figure 1(a) is obtained from the partial reconstruction of low-frequency IMF components (by summing up IMF C_6 to residue C_{12}). Therefore, the oscillating pore pressure is obtained by summing up IMF C_1 to C_5. Comparison with the result by LMAS and FFT&IFFT (Figure 3) reveals a good consistence, but the oscillating component by LMAS doesn't oscillate around the zero mean. It seems that the EEMD has only given slightly better performance. But in fact, it has at the time decomposed the records into several IMFs from high to low frequency. As a result, the EEMD method not only helps derive the means of pore pressure records correctly but also provides great opportunity to in detail analyze the characteristics of the oscillating components.

The EEMD method is further applied to decompose pore pressure records for excess components induced by regular wave groups and irregular waves as shown in Figure 1(b) and (c). Obviously, the results display that EEMD is effective to decompose wave-fluidized pore pressure records for investigating the developments of pore pressure build-ups. More detailed discussions are to be given in the full text.



(a) (b) (c)

Figure 1 – Pore pressure records (top) and components of excess (middle) and oscillating (bottom) for (a) monochromatic wave, (b) wave group and (c) irregular wave

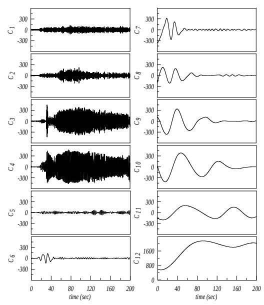
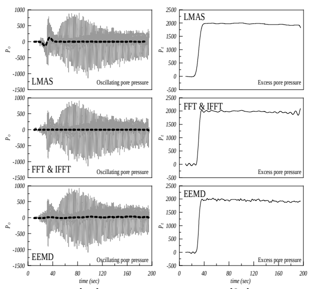


Figure 2 – The IMFs for fluidized pore pressure



(a) (b)

Figure 3 – (a) Oscillating and (b) excess components of pore pressure records

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