Effects of propagation and oscillation directions of shear waves transmitted in granular materials

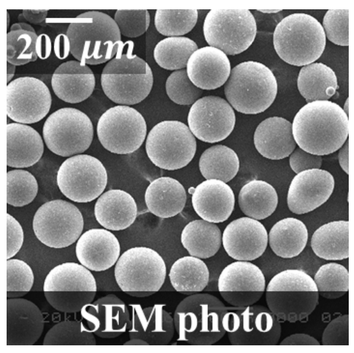
粒状体内を伝播するせん断波の伝播方向と振動方向の影響

Shear wave (S-wave) propagation, as the most versatile and portable method to obtain the small-strain stiffness of soils, has been widely used to monitor and characterize soil seismic behaviors. However, little attention has been paid to the effects of S-wave propagation and oscillation directions on the received wave signals. This research developed an original apparatus which can study the S-wave evolution in granular materials by changing either the propagation direction or the oscillation direction. Experimental results confirm that both propagation and oscillation directions are sensitive to soil inner fabric.

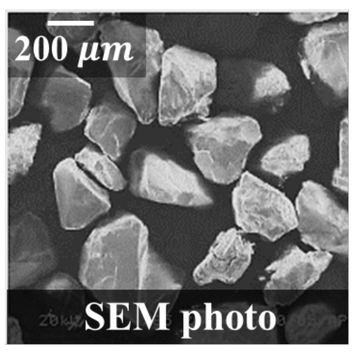
せん断波（S波）は，土の微小ひずみ剛性を得るための汎用的な方法として，土の動的特性評価に広く用いられている。しかし、S波の伝播方向や振動方向が受信波信号に与える影響についてはあまり注目されていない。本研究では，伝播方向と振動方向のいずれかを変化させて，粒状材料中のS波の変化のパターンを調べることができる独自の装置を開発した。実験の結果より、S波の伝播方向と振動方向がともに土の内部構造の影響を受けることを確認した。

Materials and Apparatus

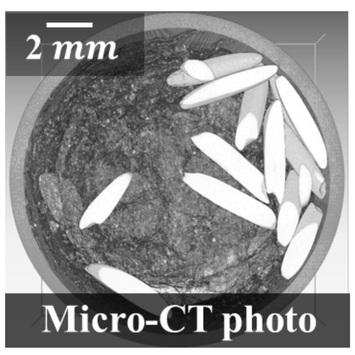
Discussions in this study are based on experimental results of four granular materials: spherical glass beads (GB) Toyoura sand (TS), basmati rice (BR) and wild rice (WR).



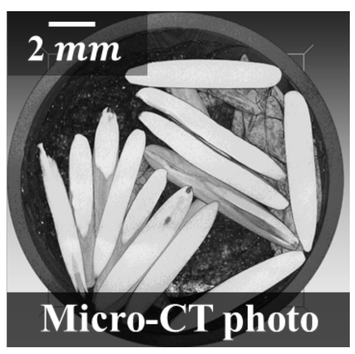
Spherical glass bead



Toyoura sand

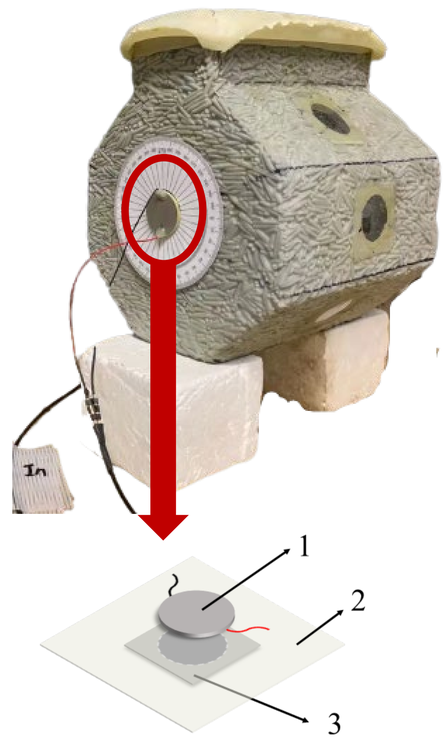


Basmati rice



Wild rice

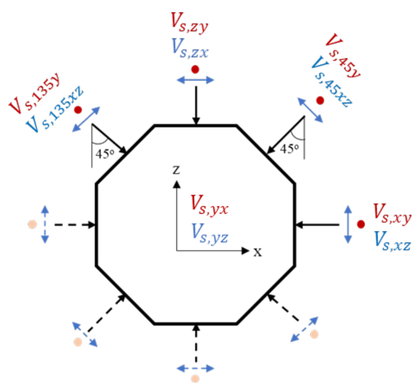
The tested materials were enclosed in the so-called eight prismatic membrane cell developed by Kuwano lab to conduct S-wave propagation tests. The apparatus can measure not only S-waves in the horizontal and vertical directions, but also in two oblique directions in 45° with respect to the vertical axis by disk-shape shear plates.



(1) 0.2 mm acrylic sheet
(2) latex membrane with an opening
(3) disk-shaped transducer

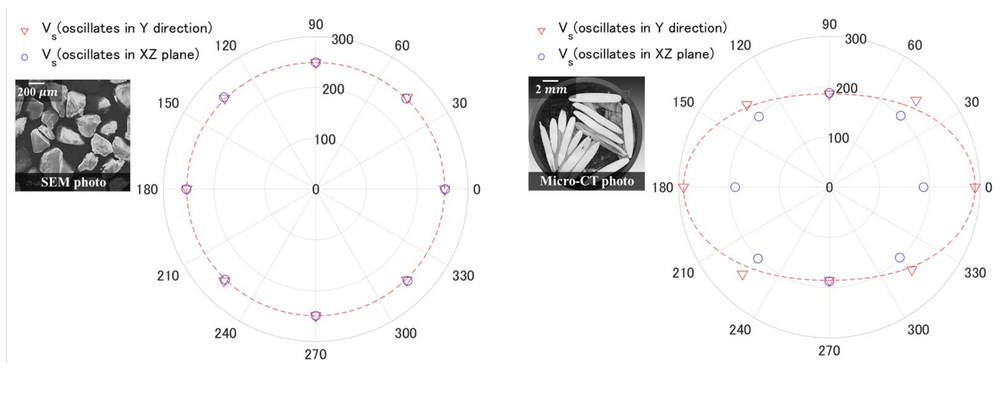
Eight prismatic membrane cell

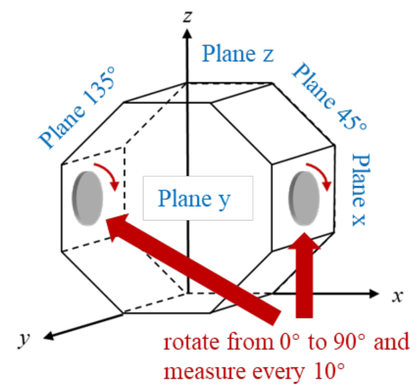
Testing Programs and Results



Variation of S-wave propagation direction

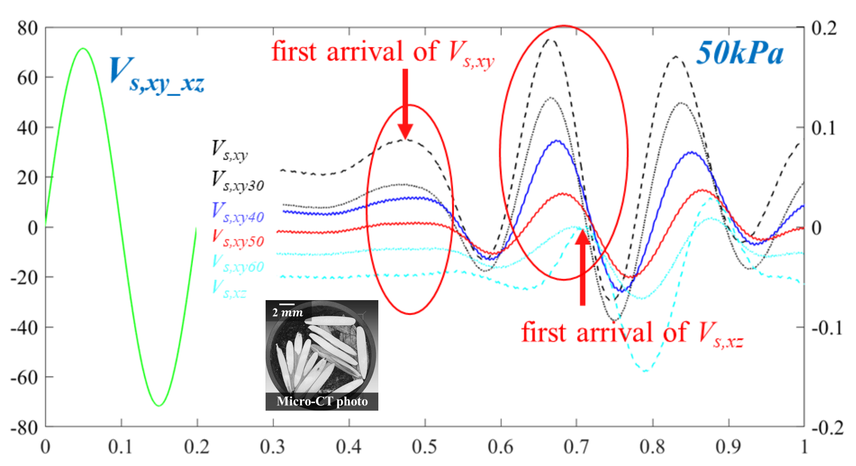
V_s in five directions are measured to evaluate the fabric anisotropy of soil specimens under isotropic confinement.





Variation of S-wave oscillation direction

V_s of S-waves propagating in the same direction but oscillating differently are measured under isotropic confinement. .



For further information, contact below.
Prof. Reiko Kuwano,
Bw-304, Institute of Industrial Science, the University of Tokyo
TEL：+81-3-5452-6843
E-mail: kuwano@iis.u-tokyo.ac.jp

Junming LIU (2022)
桑野研究室
東京大学 生産技術研究所 Bw-304
電話: 03-5452-6843
E-mail: kuwano@iis.u-tokyo.ac.jp