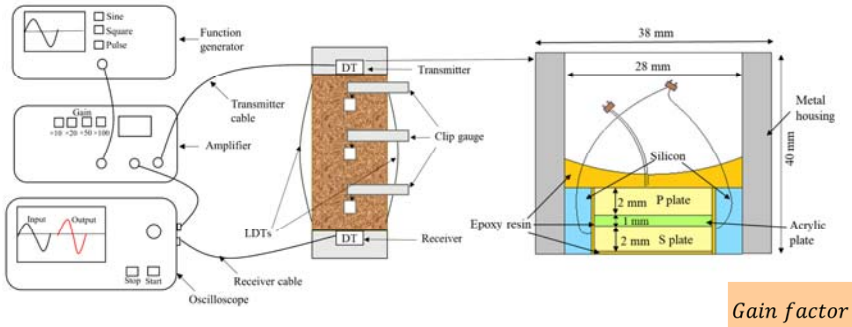
Apparent particle size dependency and selection of ideal excitation frequency range

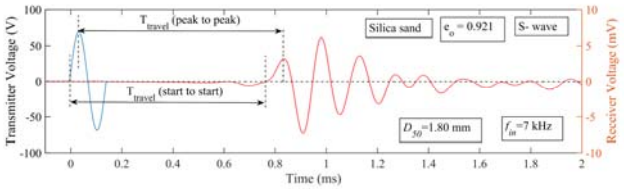
弾性波速度における粒径の影響と最適振動周波数の選択

For assemblies of spherical particles with Hertzian contacts, the stress wave velocities should not depend on median particles size (D_{50}). However, a link between D_{50} and stress wave velocity has been reported in experiments. To identify the reasons for discrepancies, wave velocity measurements were performed using disk transducers on four different D_{50} glass beads. The results indicate that shear (V_s) and compression (V_p) wave velocities are independent of D_{50}. The maximum frequency that can propagate through a granular assembly (lowpass frequency) reduces with increasing D_{50}. For V_s, selected input frequencies should match frequencies which exhibit largest gain factors and input frequencies should not exceed half of lowpass frequency. To determine V_p, it is suggested to adopt start to start method and to choose an input frequency which is slightly lower than the lowpass frequency.

Assembly for stress wave measurements



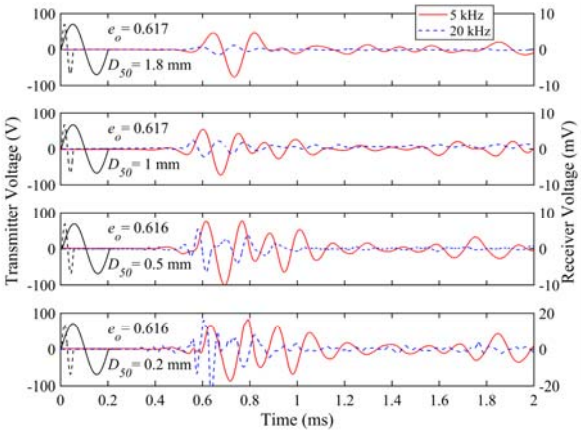
Two conventional methods for estimating travel time



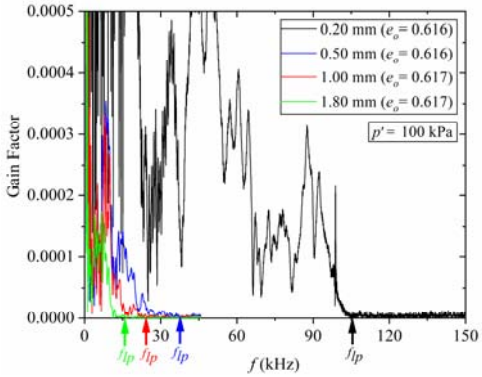
$V_s \propto Lf_{lp}$ (from dispersion theory)

$$Gain\ factor = \frac{FFT_{output}}{FFT_{input}}$$

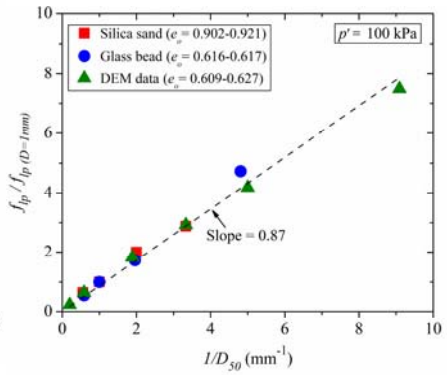
★ *Low pass frequency (f_{lp}) is the maximum transmitted frequency*



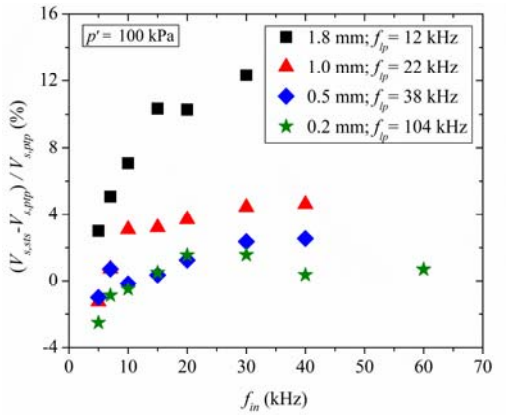
★ *S- wave travel time is independent of D_{50}*



★ *Range of frequency propagation increases with decreasing D_{50}*

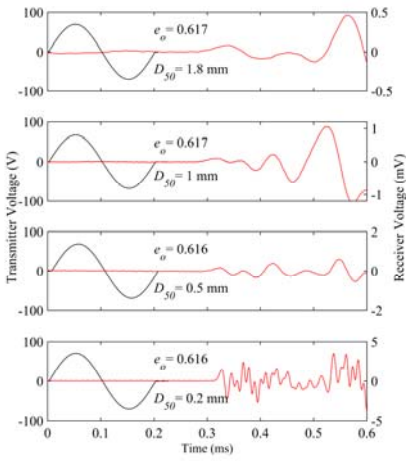


★ *Low pass frequency varies linearly with $1/D_{50}$*



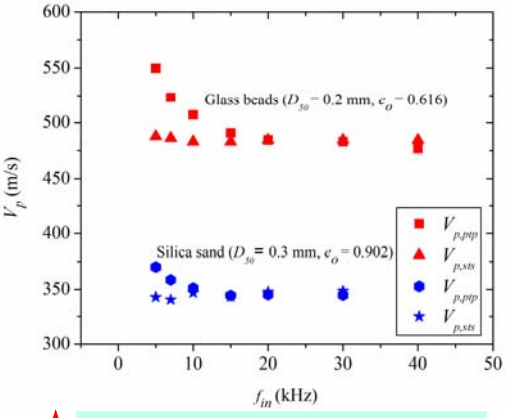
★ *% difference between V_s measured from sts and ptp increases, when $f_{in} < f_{lp}/2$*

★ *For V_s, f_{in} should match frequencies which have maximum gain factors and f_{in} should not exceed $f_{lp}/2$*



★ *P-wave travel time is independent of D_{50}*

★ *Wave lengths of output signal does not match input for lower D_{50} specimens*



★ *Peak to peak method overestimates the P- wave velocities*

★ *For V_p, start to start method and $f_{in} < f_{lp}$ should be used*

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