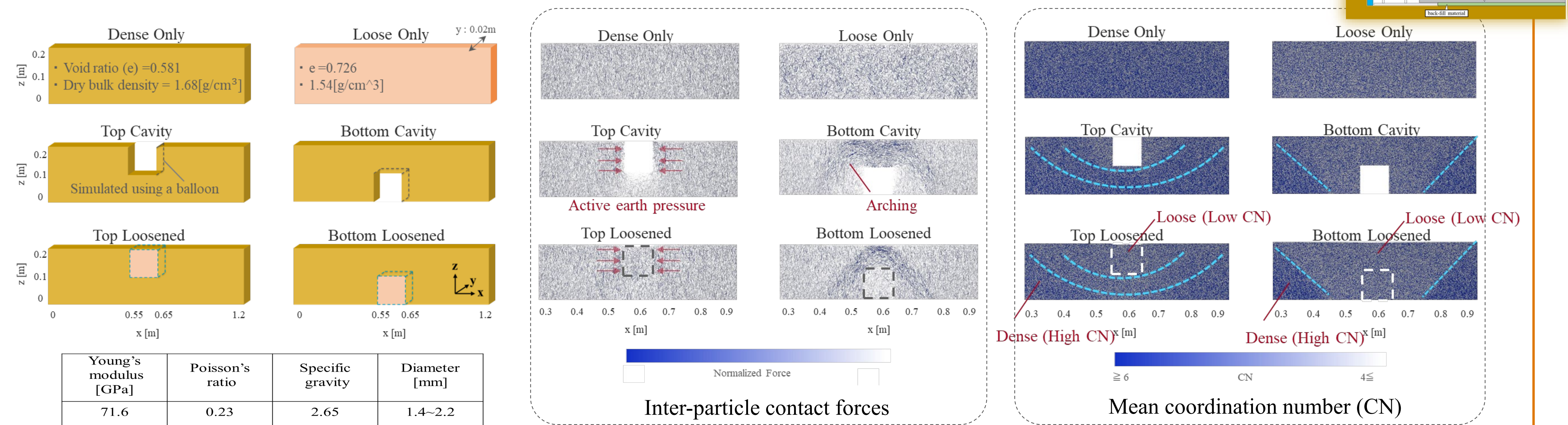


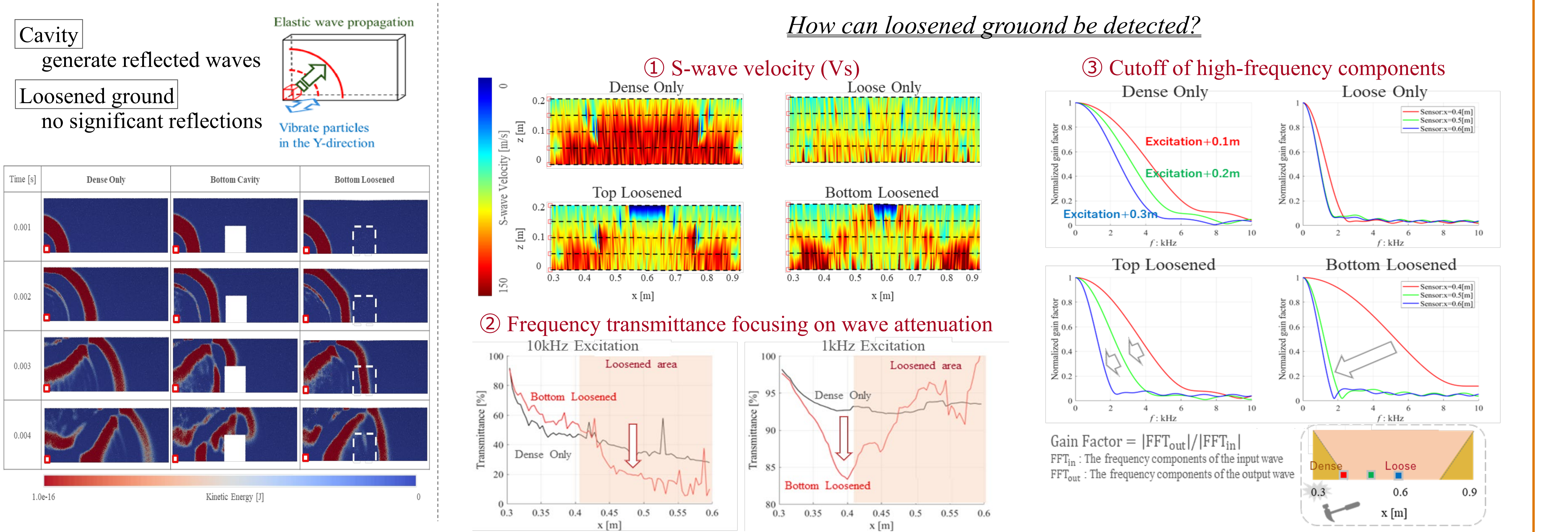
The ground cave-in accident associated with shield tunnel excavation in Chofu, Tokyo (2020) revealed the risk that cavity and loosened ground, even at great depths, can cause ground cave-ins. Current exploration methods have limitations in exploration depth, and the detailed mechanisms of elastic wave propagation around deep-seated cavity and loosened ground have not yet been clarified. Therefore, this study aims to enable early detection by elastic wave exploration from inside tunnels and conducts a fundamental study through numerical analyses (Discrete Element Method) and laboratory soil tests.

東京都調布市でのシールドトンネル掘削に伴う地盤陥没事故（2020）により，大深度における空洞やゆるみであっても地盤陥没を引き起こす危険性が新たに示された．現行の探査手法では探査深度に限界があり，また大深度空洞やゆるみ周辺における弾性波伝播の詳細なメカニズムは明らかになっていない．そこで本研究はトンネル内部からの弾性波探査により早期検知することを目的とし，数値解析と室内土質試験により基礎的な検討を行った．

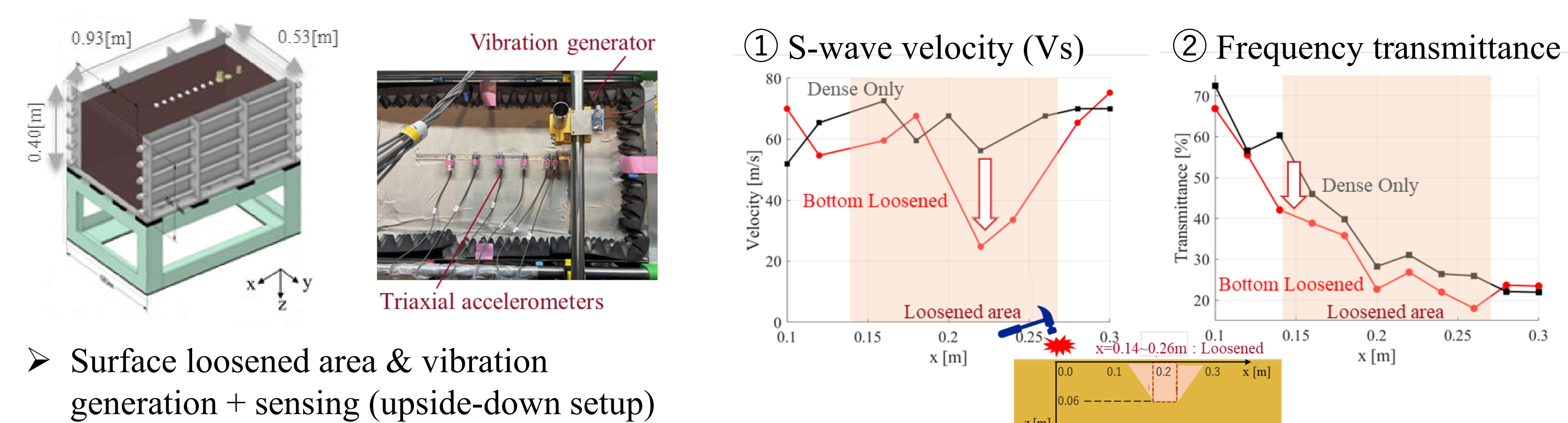
1. The Discrete Element Method (DEM) simulation method and physical characteristics of models



2. Investigation of exploration mechanisms for deep-seated cavity and loosened ground



3. Evaluation of exploration mechanisms through laboratory soil tests



4. Conclusion

- Reflected waves from cavity may enable detection of deep-seated cavity.
- In loosened area, contact forces and CN affect wave behavior (Vs reduction).
- Vs reduction, transmittance attenuation, and high-frequency cutoff are effective indicators of loosened ground.

