Fluid-solid multiphase flow simulator using a SPH-DEM coupled method in consideration of liquid bridge force related to water content

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ABSTRACT

Most of the recent natural disasters such as landslide and tsunamis are complex phenomena in which fluid, ground, structures, etc. affect each other. Therefore, it is necessary to study from various mechanical viewpoints. Among them, in this research, we focus on "soil-water mixed phase flow" where fluid and soil affect each other, such as slope failure and ground collapse. In this study, referring to Harasaki et al.[1] ,ISPH method is applied for fluid simulation while DEM is applied for modelling of soil behaviour. Then, a general-purpose fluid-solid multiphase flow simulator is developed using the ISPH-DEM coupling method.

In addition, in DEM analysis, there are problems in consideration of soil particle shape and apparent cohesion related to water content. In our analysis method, rolling friction is introduced in order to reproduce steep slopes such as angle of repose. Furthermore, in order to adapt to unsaturated ground, the liquid bridge force model proposed by X.Sun et al.[2] is introduced.

By using the analysis method described above, we succeeded in qualitatively reproducing the process from the generation and development of cavity under the ground to the ground collapse. At present, as a verification example of the SPH-DEM coupled analysis method proposed in this research, solitary wave collision experiments on sands are taken up, and reproduction analysis is being conducted. In this analysis, changes in sand pile shape after solitary wave collision and treatment of wave making equipment are discussed. The simulation of the sea wall destruction will be done with this SPH-DEM coupled method for the future work.

REFERENCES

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