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MODIFICATION OF THE LEAST SQUARE MPS METHOD FOR THE HEAT CONDUCTION PROBLEMS

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In this work, new formulations for the heat conduction problems based on the Least Square Moving Particle Semi-implicit (LSMPS) method [1] are presented in order to simulate a laser irradiation onto a thin plate. It is well known that the least-square-based particle methods such as the LSMPS method are much more accurate than the normal particle methods although they do not guarantee the conservation of the physical variables such as the momentum and energy. The LSMPS method can be applied to various practical simulations successfully with the exception of the cases in which the thermal energy is not conserved when the heat conduction with the laser irradiation is simulated.

The LSMPS method is modified to make the thermal energy conserved in the simulation of the laser irradiation. The new formulations for the discretisation of the heat conduction equation are proposed based on the heat flux between particles so that they exchange the same amount of the thermal energy with each other. Additionally, three kinds of formulations for the heat fluxes between particles (LSMPS-like, MPS-like and hybrid flux) are proposed and the performance of each scheme is verified. Furthermore, the ellipsoidal particle modelling [2] is extended for the LSMPS method to model a thin plate with a high aspect ratio, which is very hard to be represented by spherical particles.

The heat conduction with an analytical solution was simulated with the proposed formulations and the temperature distributions were compared with the correct answer. It was found that the accuracy of each formulation for the heat flux depends on the particle distribution and only the hybrid flux method provides the accurate results for any particle distributions. By demonstrating the laser irradiation onto a thin plate and comparing the temperature variation with the experimental result, it was confirmed that the proposed method could be used in the practical simulations properly.

REFERENCES

[1] M. Tanaka, R. Cardoso and H. Bahai, Multi-resolution MPS method, *Journal of Computational Physics*, In press, (2018).

[2] K. Shibata, S. Koshizuka and I. Masaie, Cost reduction of particle simulations by an ellipsoidal particle model, *Computer Methods in Applied Mechanics and Engineering*, 307, 411-450 (2016).