Moving Particle Simulation for Medical Application

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Moving Particle Simulation (MPS) method was developed to analyze incompressible flow accompanied by violent free surface motion using a semi-implicit algorithm [1]. The MPS method was then applied to elastic solid dynamics using a fully explicit algorithm [2]. To date, the MPS method is widely used in various problems in fluid and solid dynamics [3].

Without mesh, the particle methods are expected to be useful in biomechanics, where large deformation of soft organs is to be analyzed. The lung deformation due to breathing is analyzed to improve the radiation therapy for cancers. A diaphragm motion model and a rib motion model are developed and these models can be used as the boundary conditions in the lung deformation simulation.

Breast motion due to gravity needs to analyze for matching the images taken with supine and prone positions. The breast shape in supine position, where ultrasonography is performed, is evaluated from that in prone position, where MRI (Magnetic Resonance Imaging) is performed. Motion of breast cancers will be identified using the present simulation.

Swallowing is complex motion in the throat. Simulation of the detailed swallowing process will be helpful to consider choking and swallowing disorder. Particularly, swallowing disorder is more important for elderly people who have risks for pneumonia.

Keywords: MPS, Biomechanics, Lung Motion, Breast Motion, Swallowing

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