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The contactless measurement of forces which affect a magnetic particle in a fluid and its manipulation SUSUMU TOKURA, MASAKAZU HARA, NORIHITO KAWAGUCHI, JUN IZAWA, Research Laboratory, IHI Corporation, NAOYUKI AMEMIYA, Department of Electrical Engineering, Kyoto University — The magnetic force has been used for the drug delivery, the cell/DNA manipulation, and other handlings of micro or nanoparticles. When magnetic particles are suspended in a fluid, they are influenced by the magnetic force caused by the magnetic field gradient, the gravity force, and the buoyance force. The magnetic torque also affects them to align their magnetic moments to the direction of the applied magnetic field. Furthermore, the viscous force or the force between the magnetized magnetic particles themselves cannot be neglected. In this study, methods of the quantitative measurement of these forces and the manipulation of a magnetic particle were developed. Four electromagnets were used to apply magnetic fields to ferrite particles (300nm-300μm) in a fluid in a vessel. The particle tracking velocimetry method was used to visualize the behavior of the particles. Based on the theory of the magnetic suspension and balance system, the vertical and horizontal forces affected a magnetic particle were estimated from the current in the coil of each electromagnet without any physical contact to it. And, the contactless manipulations of the magnetic particle suspended in the stagnated or flowing fluid by controlling the coil currents were demonstrated successfully.

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