Construction of mathematical models for phase transition phenomena, and making up mathematics teaching materials which adopted mathematical modeling

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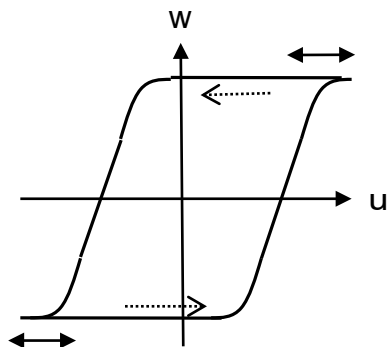Associate Professor, Dr. Sci.

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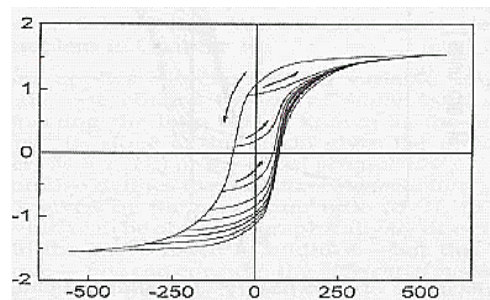| Research Fields	Natural Sciences
Keywords	Applied mathematics, Numerical simulation, Mathematics education

● Research Outline

Construction of Mathematical models for phase transition phenomena

The first research subject is to construct mathematical models for phase transition phenomena by using differential equaion and to simulate it. Phase transition phenomenon is a conversion of a solid into a liquid, a liquid into a solid, for instance. Especially we are interested in a hysterersis phenomenon. Hysteresis phenomenon is that the state changes depending on a past history. Even if the phenomenon is reversible, it is called hysteresis if return is different from a way (see figure. 1). We call the orbit in figure. 1 hysteresis loop. We can see the loop in a relation between an outside magnetic field and a magnetic induction, a play of the steering wheel in the steering wheel operation of a car, a shape memory alloy.
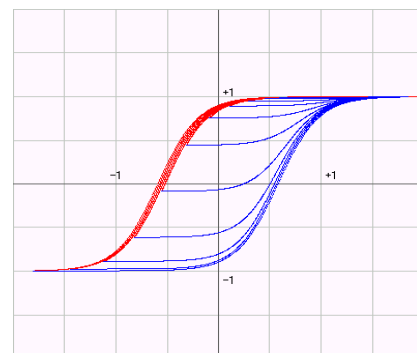

(Figure. 2)

hyeteresis loop in magnetization process

(Figure. 3)

reproduce hysteresis loop by mathematical model

(Figure. 1) hyeteresis loop

From phenomenological point of view, we construct mathematical models of hysteresis which is described by differential equation and make sure its validity by numerical simulation. Figure. 2 is the hysteresis loop between outside magnetic field and a magnetic induction which is obtained by an experiment and Figure. 3 is the numerical simulation by using mathematical model. We see that our mathematical model reproduce hysteresis loop. I will try the modeling of various hysteresis phenomena in future.

Making up a mathematics teaching materials which adopted mathematics modeling

The second research subject is to make up a mathematics teaching materials which adopted technique of the mathamatics modeling, so that students can experience the usefulness of mathematics. I development the teaching materials and practice it now.