The Levitation Mass Method
-precision measurement method for dynamic force-

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Abstract. The Levitation Mass Method (LMM), a method for generating and measuring for dynamic force, is reviewed. In the LMM, A rigid body with known mass is levitated using an aerostatic bearing. The rigid body called “the mass” can move with negligibly small friction. When the mass collides with a test target, the motion of the mass changes according to the equation of motion, $F = ma$, where $F$ is a force acting on the mass, $m$ is the mass of the rigid body and $a$ is the acceleration of the mass. $m$ can be measured precisely by electric balance. $a$ also can be measured precisely by an optical interferometer. Therefore, the force acting on the mass can be measure precisely. We can only measure the Doppler frequency modulated by the motion of the mass. The velocity, acceleration, position and force are calculated from the Doppler frequency. Then, we can obtain strictly synchronized values of velocity, acceleration, position and force. We have investigated a correction method of dynamic error of force transducer, many kinds of material testers and a mass measurement device for astronauts. These applications of the LMM including latest research are reviewed.