

## **Permanent Magnet Levitation Stabilized by Diamagnetic Materials: A case-study.**

Dr. Ing. Cazacu Emil,  
Polytechnic University of Bucharest, Electrical Engineering Department,  
313 Splaiul Independentei, RO 060042, Bucharest, Romania,  
e-mail: cazacu\_emil@yahoo.com

Free stable static levitation of permanent magnets in stationary fields with no energy input is not allowed according to Earnshaw's theorem. However, the introduction of diamagnetic material at special location can stabilise this levitation, obtaining two distinct suspension arrays: vertical and radial. These compact implementations work without superconductors and may require no energy input. For the vertical stabilised configuration, this paper establishes the equilibrium and stability condition using an analytical procedure of magnetic field computation. A numerical approach was also made, suggesting a very useful tool in designing such instruments. An experimental model of the configuration based of strong permanent magnets (NdFeB) and pyrolytic graphite validates these analytical and numerical results. The applications of these levitation devices concern the designing of ultra-sensitive measurement instruments used where sensitivity to minor variation of the gravitational field is required. Diamagnetic levitation using ordinary magnets is also ideally suited for micro and nano electromechanical devices such as ultra-sensitive tiltmeters and accelerometers, vacuum sensors, micro motors, micro robots and many others.