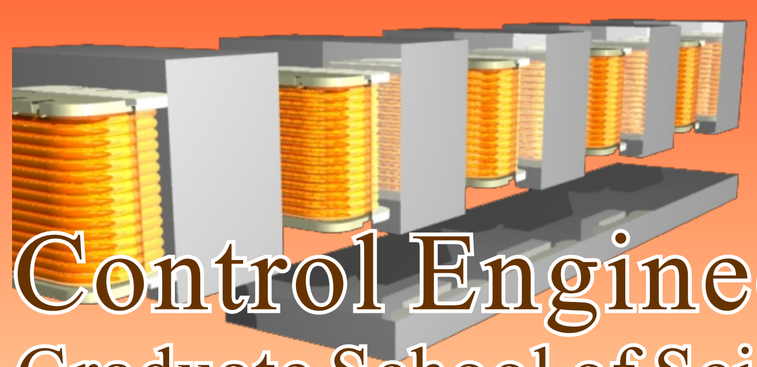

Development of a Wind-Tunnel for Spining Body Using Magnetic Suspension

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Abstract

A wind tunnel system for a spinning body has been designed for the measurement of the hydrodynamic forces acting on the body. The body was successfully suspended and rotated by electromagnets. For further development and control, it is important to understand the exact magnetic flux distribution inside the system as well as the variation of the force with the increase of the current. The magnetic flux distribution and magnetic force acting on the suspended object are obtained. The magnetic flux densities are analyzed for the variation of current in elecomagnets.Experimental results support the results obtained by numerical analysis.

Introduction

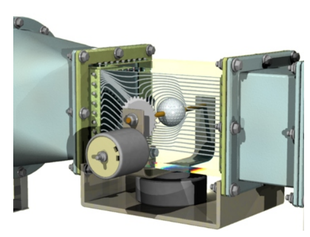
Wind tunnel experiment for different sports ball

Fixing the ball with a support is mandatory in conventional system

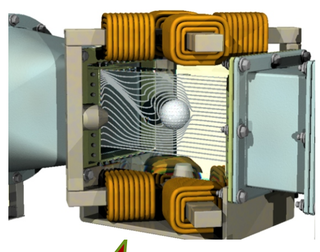
To get the accurate experimental result the ball should be kept free of support

Solution

Suspend the ball Magnetically

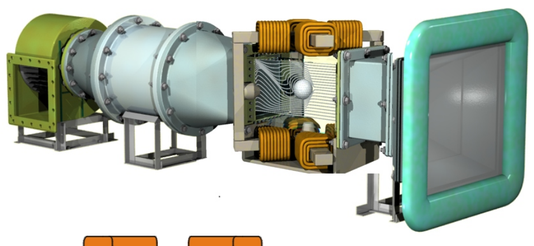


Conventional System



Proposed System

Principle

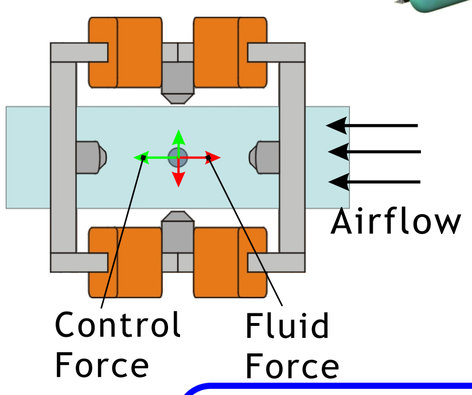


Ball is kept fixed and levitated at the center position

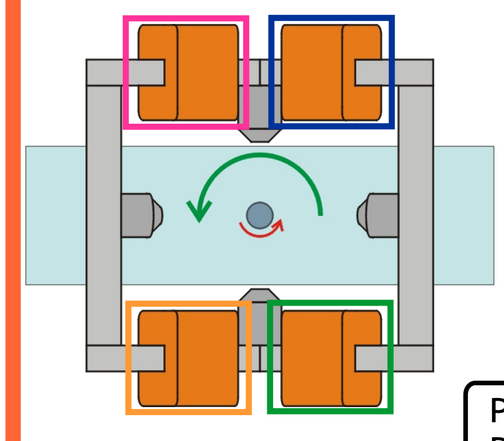
Wind speed is varied

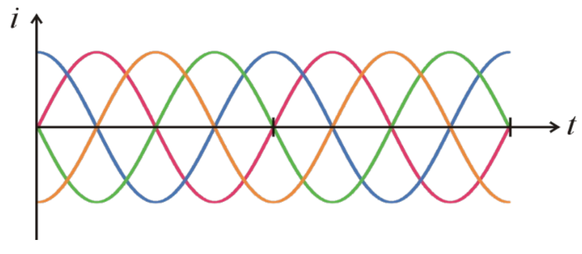
Control force minimizes wind force

Fluid force is measured from control force



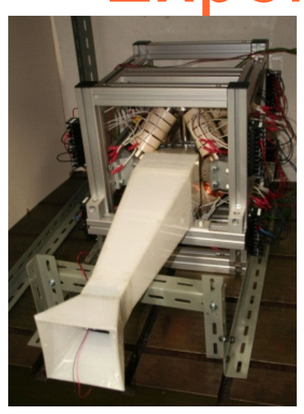
Principle of rotation

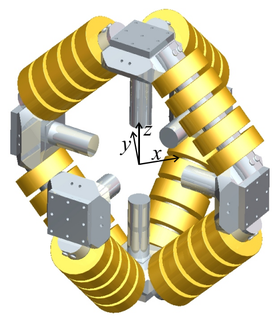




Principle is like induction motor. Phase change of current is used to activate coils one after another

Experimental Apparatus





Electromagnet

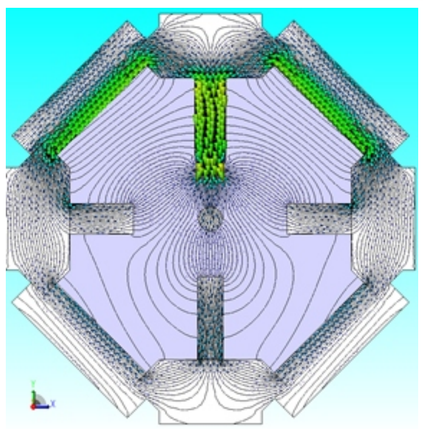
Total 8 sets of electromagnets each contains 5 windings

Wire Diameter: 1 [mm]

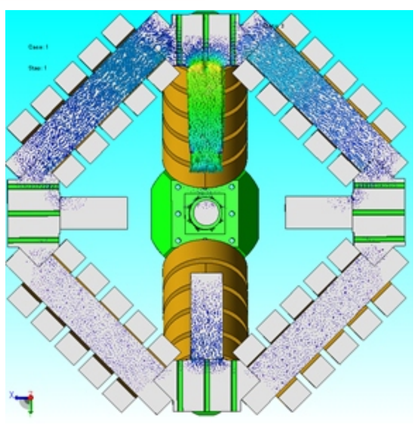
Number of Turns: 300

Electromagnetic Analysis

Magnetic flux flow pattern

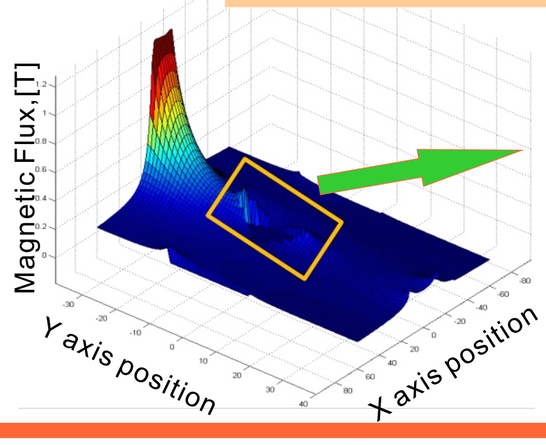


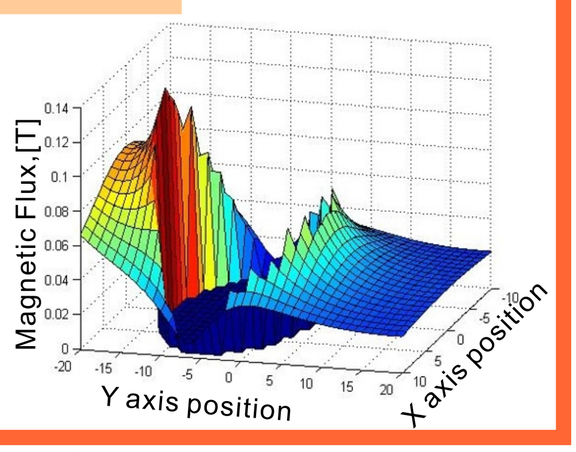
2D analysis



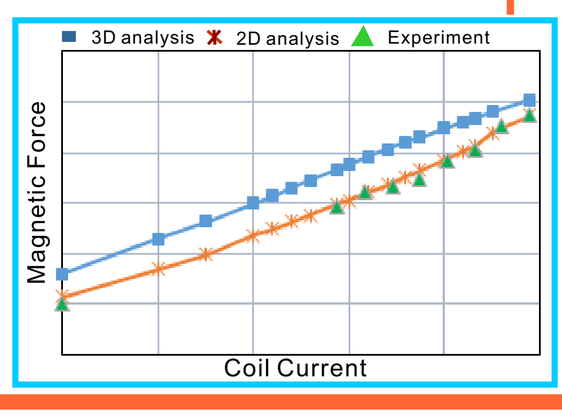
3D analysis

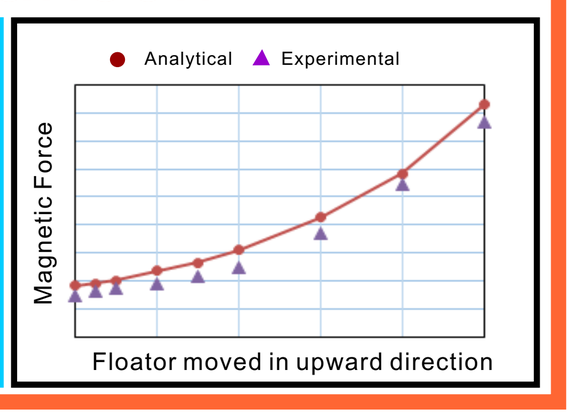
Magnetic flux distribution





Comparison





Future Plan

Development of a new setup where 100X100 mm wind tunnel can be placed for getting accurate aerodynamic characteristics

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