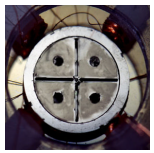
Title	Enhanced Functional Device Technologies (M500)
	Ultra Low Frictional Micro-suspension Device (M530)
Organization	Royal Melbourne Institute of Technology

Summary



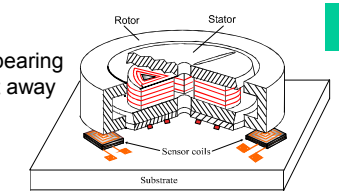
Assembled bearing

Research Overview

Project Target: Micro Magnetic Bearing

- Assembled – actual size bearing under test
- Planar Processing – under fabrication

Planar bearing (3-D cut away view)



Important Issues:

- Permalloy, Cu, Au plating
- Pole face shaping by laser micromachining
- Multilayer coils
- True 3-D high aspect ratio structures

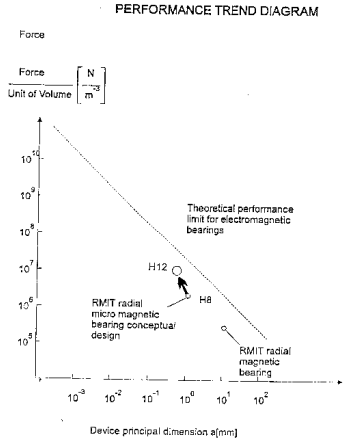
Purpose and Background

R&D of low frictional micro-suspension device for establishing the enhanced functional device technologies of the micromachine.

Goal

Development of non-contact electromagnetic bearing for reducing the mechanical friction of the micro gear of 1mm to 3mm outside diameter

- Assembled Bearing
- Planar Process Bearing



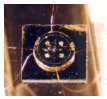
Breakthrough Point and the Solution

M530

Breakthrough Point	Solution
1. Complex 3-dim structures	1. Fringing range method improve design efficiency
2. Manufactureable topologies and design tools	2. New processing techniques implemented
3. Limited output force/volume	3. Materials with improved magnetic properties
4. Smart position sensor needed	4. Eddy current sensor & control system developed
5. Sensor cross-talk between orthogonal axes	5. Modify sensor coil mounting arrangement
6. Test rig design for measuring static forces	6. Rig design in progress
7. Severe stress problem with Au coils	7. Adopted Cu plating
8. Ms too low and high residual stress	8. Study properties of Permalloy 45 and others and develop suitable electroplating system
9.Rotation after levitation of rotor	9.More time and facilities needed

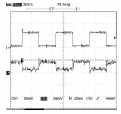
Results

(a) Assembled Bearing



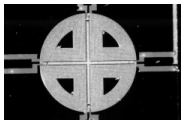
Specifications

- Accurate dimensions of stator (OD2600 μm) and rotor sections achieved with air gap of 20 μm
- Levitation achieved in x, y, and z axes with maximum rotor displacement 20 μm and maximum sensor sensitivity 20mV/ μm
- Good angular stability due to consideration of pole face angles
- Bias current 30 mA
- Maximum control current 45 mA
- Figures show closed loop feedback response using PD control system (extreme difficulty in adjustment at present time)

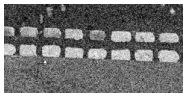


(b) Planar process bearing

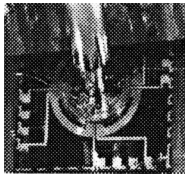
hybrid with assembled stator



Two layer coil--- plan view



Two layer coil--- cross section view



- Levitated micro rotor in hybrid micro bearing.
- Rotation needs more facilities and time

Future Visions

Apply micro magnetic bearing suspension technology to :

- micro strap down rotating gyroscopes using force balance principles
- micro spinning rotor vacuum gauges

Potential applications

- man portable global positioning systems and portable precision vacuum systems
- cameras and hand held instruments, robotics, and space applications

Commercial development plans

- Demonstrate primitive applications of concepts and refine performance of devices
- Approach Japanese and other companies with a view to further commercial development of these devices