Dynamic Characteristics in The Horizontal Direction for New Type SMB Using SC Bulk and SC Coil

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ABSTRACT

Superconducting magnetic bearings (SMBs) are usually composed of superconducting (SC) bulk and permanent magnet (PM). These SMBs are based on pinning forces between SC bulk and PM.

In this paper, new type SMBs composed of SC bulk, SC coil and PM are proposed. In order to compare SMB Type-I with Type-II, impulse responses in the horizontal direction are performed.

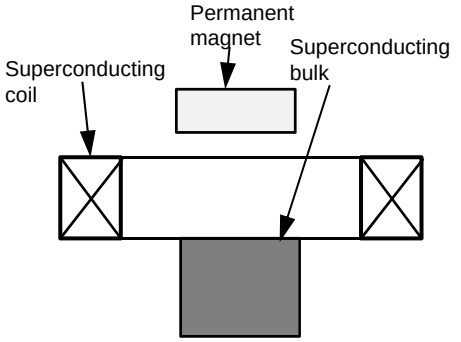

Fig.1. SMB Type-I

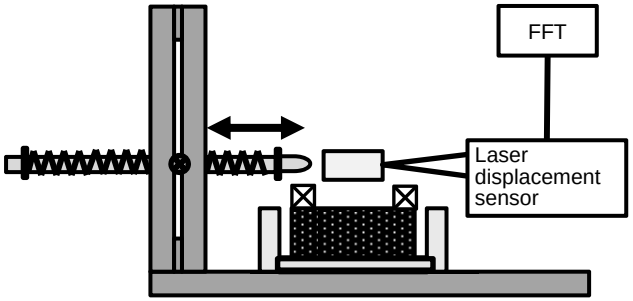

Fig.2. Experimental setup for impulse responses

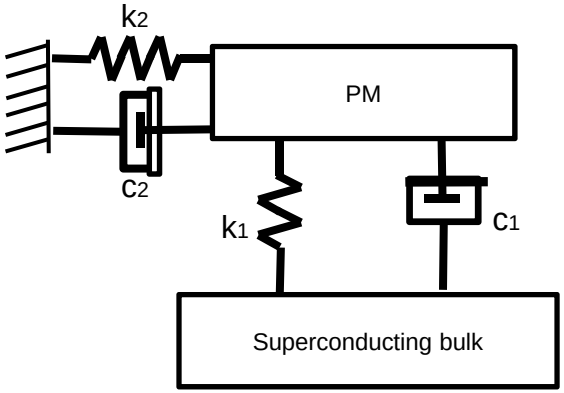

Fig.3. Mechanical model of SMB with a spring and a damper in the vertical direction and with a spring and a damper in the horizontal direction.

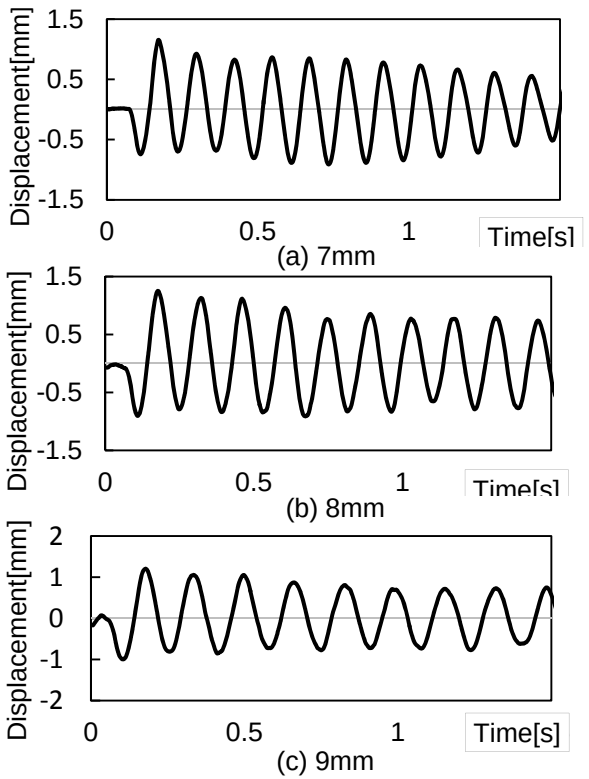

Fig.4. Impulse responses in the horizontal direction for the SMB Type-I without SC coil at various distances of 7, 8 and 9mm

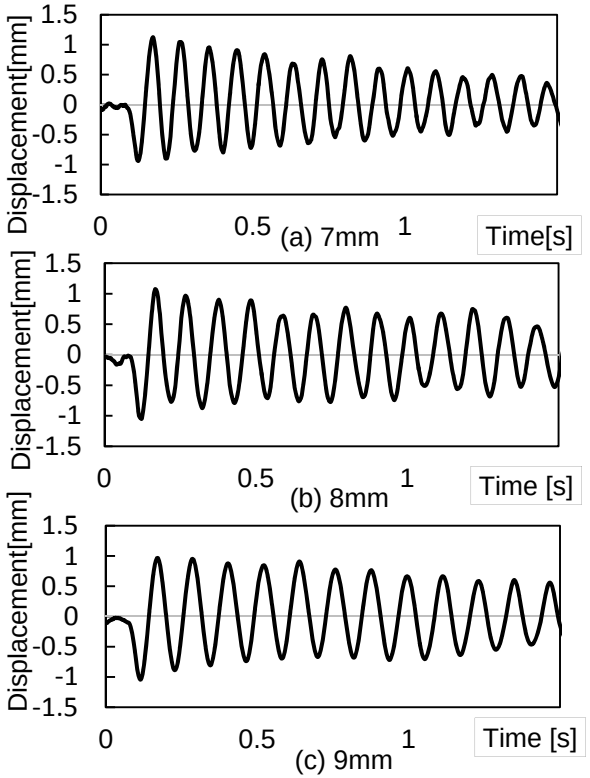

Fig.5. Impulse responses in the horizontal direction for the SMB Type-I with SC coil at various distances of 7, 8 and 9mm

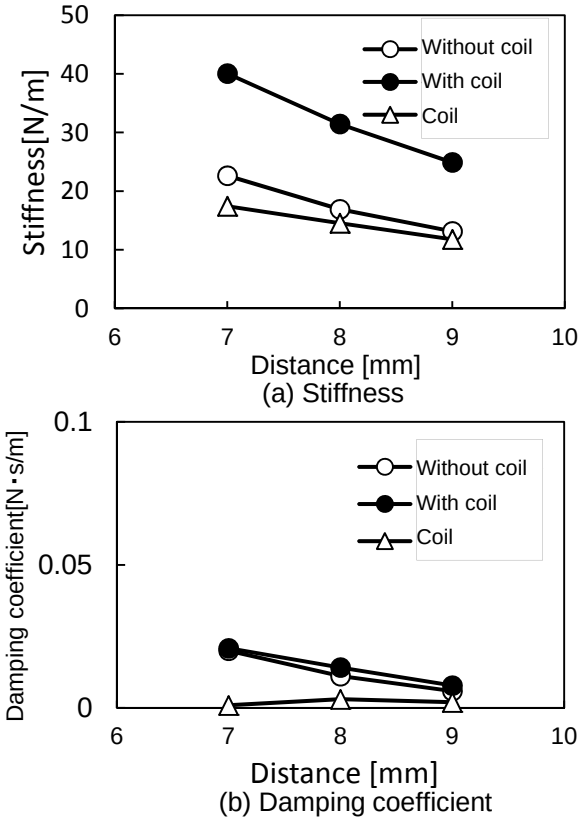

Fig.6. Relationships between (a) stiffness and distance and (b) damping coefficient and distance for three cases

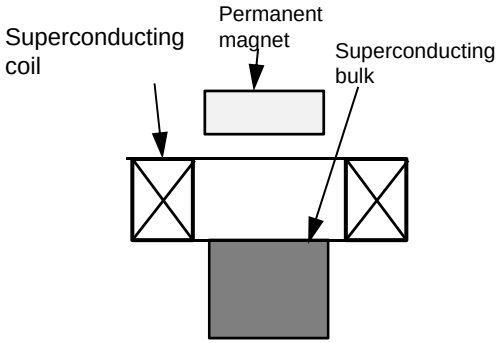

Fig.7. SMB Type-II

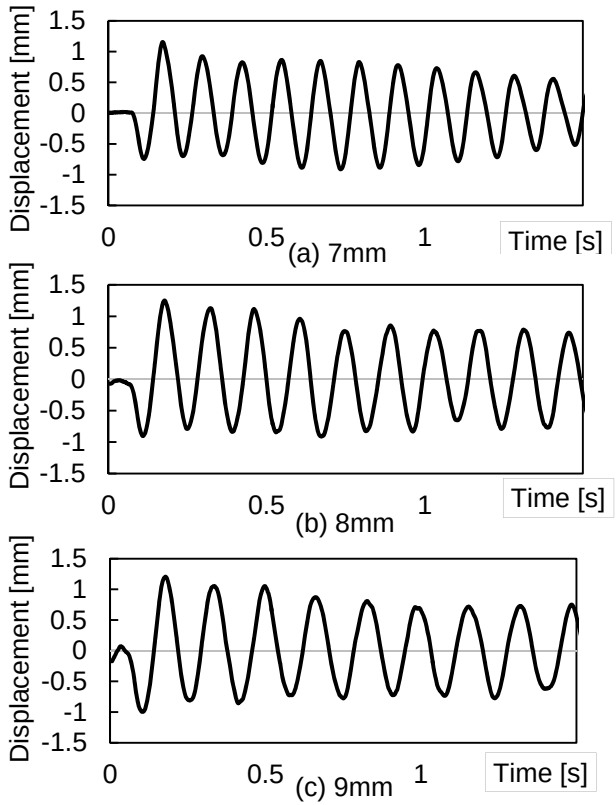

Fig.8. Impulse responses in the horizontal direction for the SMB Type-II without SC coil at various distances of 7, 8, and 9mm

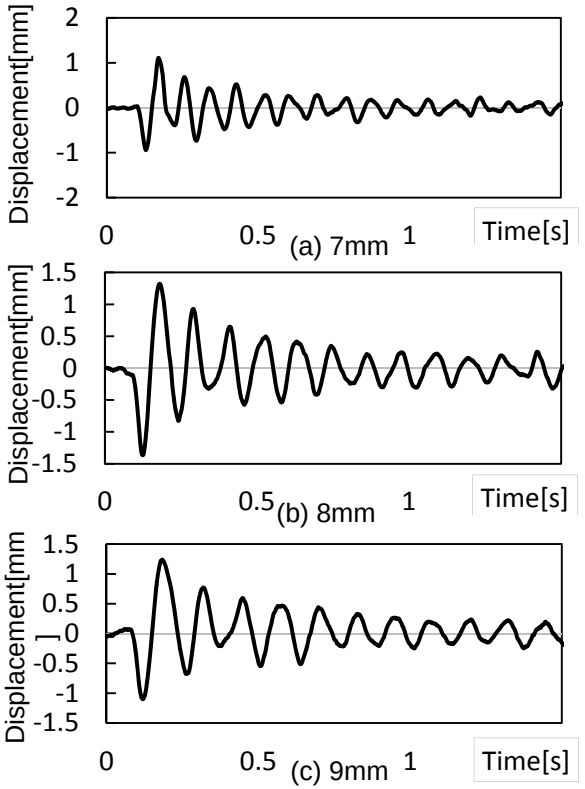

Fig.9. Impulse responses in the horizontal direction for the SMB Type-II with SC coil at various distances of 7, 8, and 9mm

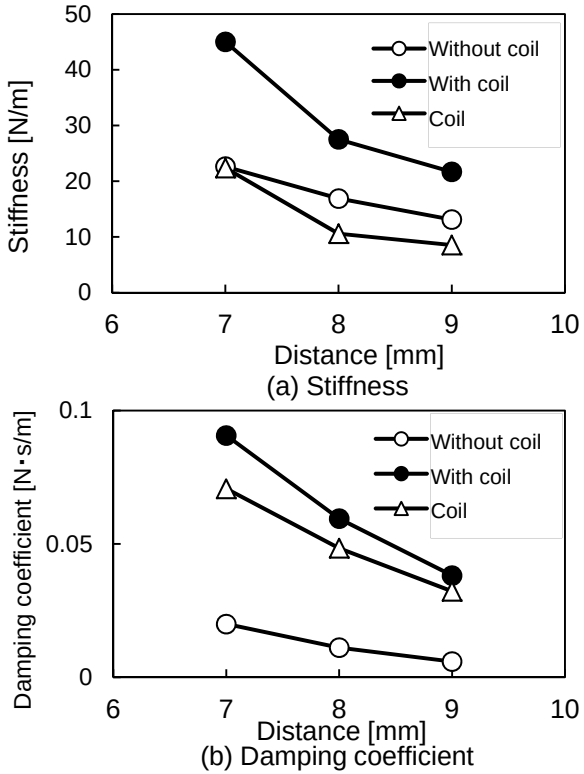

Fig.10. Relationships between (a) stiffness and distance and (b) damping coefficient and distance for three cases

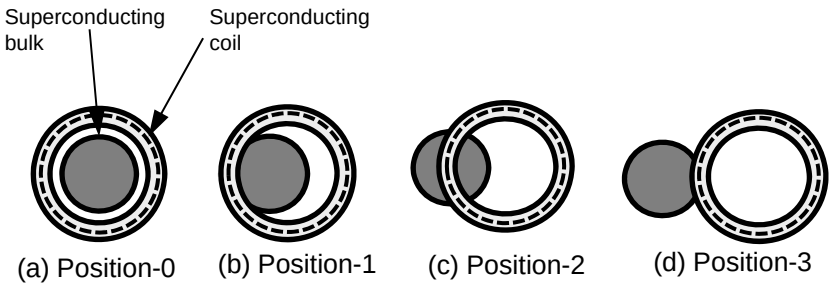

Fig.11. SMB Type-I in the cases of Position-0, 1, 2 and 3.

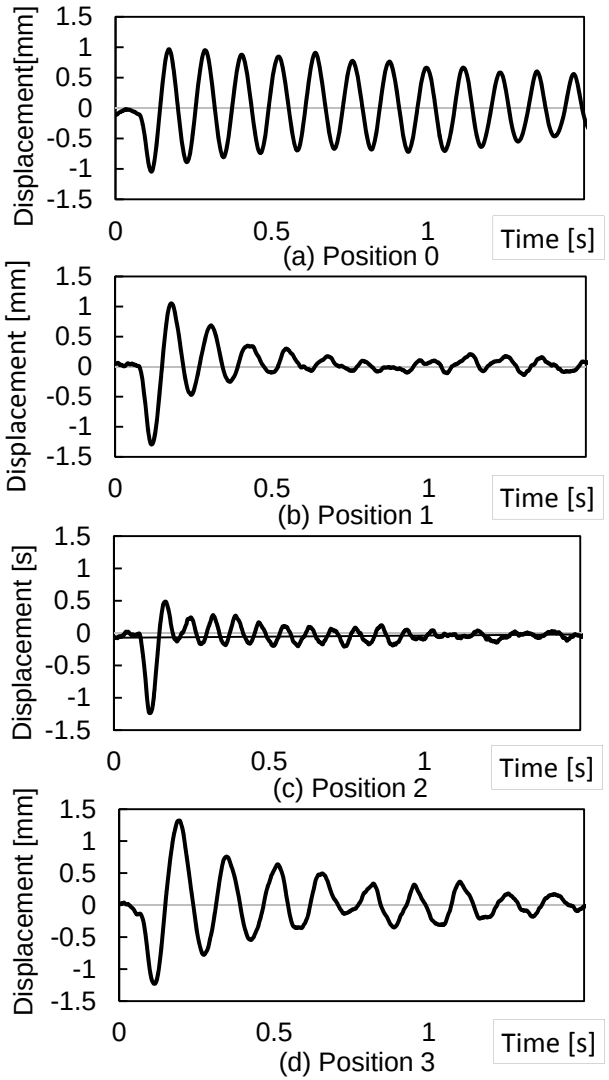

Fig.12. Impulse responses of SMBs in the cases of positions-0, 1, 2 and 3.

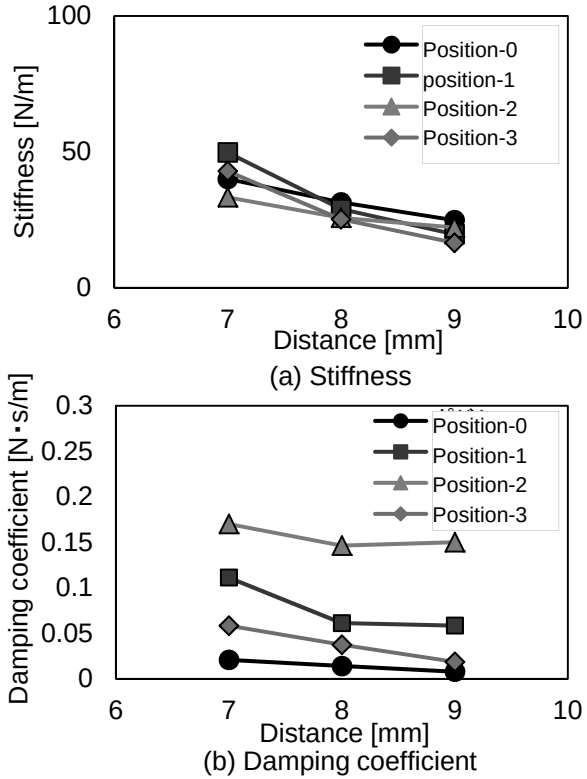

Fig.13. Relationships between (a) stiffness and distance and (b) damping coefficient and distance in the cases of Position-0, 1, 2 and 3.

CONCLUSION

- ✓ It is found that the SMB Type-I is effective on stiffness.
- ✓ The SC coil of SMB Type-II is more effective on both stiffness and damping coefficient than the SMB Type-I.
- ✓ The stiffness doesn’t depend on the SC coil position. However the damping coefficient depends on the SC coil position so much.
- ✓ This is caused by the change in magnetic flux in the SC coil when the PM vibrates in the horizontal direction.