33/1/1731 Britcher, C.P. Some aspects of wind tunnel magnetic suspension systems, with special application at large physical scales.

Despite over a quarter of a century of development, wind tunnel magnetic suspension and balance systems (MSBSs) have so far failed to find application at the large physical scales necessary for the majority of whole model aerodynamic testing. Recent developments, such as the cryogenic operation of wind tunnels and advances in superconducting electromagnet technology have greatly reduced the apparent cost of a large, or perhaps more specifically, high Reynolds Number MSBS (LMSBS). Many difficulties remain, however, and three are addressed in this thesis.

A powerful method of magnetic roll torque generation is essential for any LMSBS. Two variants of the new Spanwise Magnet scheme are studied herein. Spanwise Permanent Magnets are shown to be a practical method and are experimentally demonstrated using the Southampton University MSBS, though precise evaluation of maximum torque capabilities has not been possible.

Extensive computations of the performance of the Spanwise Iron Magnet scheme indicate potentially powerful capability, limited principally by current electromagnet technology. Some experimental verification of the computed performance at low applied field levels is presented.

Aerodynamic testing at extreme attitudes is shown to be practical in relatively conventionally configured MSBSs. Preliminary operation of the Southampton University MSBS over a wide range of angles of attack is demonstrated.

The impact of a requirement for highly reliable operation on the overall architecture of LMSBSs is studied. It is shown that the system's cost and complexity need not be unduly increased, provided certain of its unique characteristics are exploited.