

**CONTROLLED UMP IN ELECTRICAL MACHINES CAN STABILIZE OTHERWISE UNSTABLE MACHINES**

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**ABSTRACT**

There are several known mechanisms by which instability can come about in rotating machines. These include orthotropic stiffness properties of the rotor, internal damping in the rotor, skew-symmetric terms in the bearing stiffness matrix for short hydrodynamic bearings, circulatory forces in seals, and unbalanced magnetic pull (UMP) in electrical machine air gaps. What is still very little realized is that it is straightforward in virtually all electrical machines to incorporate very small design modifications such that these machines can be sources of lateral force as well as sources of torque. A previous paper has shown that the response to unbalance of a shaft-line can be dramatically subdued by using this force.

This paper considers three examples where a shaft-line including an electrical machine is inherently unstable (orthotropic rotor stiffness, bearing stiffness skew-symmetry and seal circulatory forces) and shows that stability can be restored through the intelligent use of lateral forces from the machine. The impact on the performance of the electrical machine is shown to be undetectable.