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IMPROVEMENT TO PERFORMANCE OF SOLID-ROTOR-RINGED LINE-START AXIAL-FLUX PERMANENT-MAGNET MOTOR

A. Mahmoudi*, S. Kahourzade, N. A. Rahim, and H. W. Ping

UM Power Energy Dedicated Advanced Centre (UMPEDAC), Engineering Tower, Faculty of Engineering, University of Malaya, Kuala Lumpur, Malaysia

Abstract—This paper presents two design-and-analysis cases of a line-start axial-flux permanent-magnet motor: with solid rotor and with composite rotor. For a novel structure of the motor, two concentric unilevel spaced raised rings are added to the inner and outer radii of its rotors to enable auto-start capability. The composite rotor was coated by a thin (0.05 mm) layer of copper. The basic equations for the solid rotor ring were extracted. The motor's lack of symmetry necessitated 3D time-stepping finite element analysis, conducted via Vector Field Opera 14.0, which evaluated the design parameters and predicted the motor's transient performance. Results of the FEA show the composite rotor significantly improving both starting torque and synchronization capability over solid rotor.

1. INTRODUCTION

Line-start permanent-magnet (LSPM) motors compete with induction motors in many constant-speed applications such as fans, pumps, and compressors; their fulfilment of electric motor applications is sizeable where high efficiency, small size, high power factor, and high power density are required [1, 2]. They, however, have poor starting torque and poor synchronization (both greatly depending on motor and load parameters), and sometimes they cannot start, or fail to synchronize, post early start-up [3].

Permanent-magnet machines generally can be axial-flux or radial-flux [4]. Advantages of axial-flux permanent-magnet (AFPM)

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* Corresponding author: Amin Mahmoudi (amaminmahmoudi@gmail.com).