# Soutenance d'une thèse de doctorat
# De l'Université de Lyon
# Opérée au sein de l'INSA Lyon

La soutenance a lieu publiquement

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| **Titre de la thèse** | « Modélisation multi-physique de machines électriques basée sur l'approache angulaire pour l'analyse des comportements dynamiques sous influence de différentes architectures » |
| **Date et heure de soutenance** | 01/09/2021 à 10h30 |
| **Lieu de soutenance** | Amphithéâtre Emilie du Châtelet (Bibliothèque Marie Curie) (Villeurbanne) |

## Composition du Jury

| Civilité | Nom | Prénom | Grade / Qualité | Rôle |
|---|---|---|---|---|
| MME | LEMAIRE SEMAIL | Betty | Professeur des Universités | Rapporteur |
| M. | CHEVALLIER | Gael | Professeur des Universités | Rapporteur |
| M. | MCCLELLAND | Mike | Directeur R&D, Docteur | Examinateur |
| M. | CLERC | Guy | Professeur des Universités | Examinateur |
| M. | HETZLER | Hartmut | Professeur des Universités | Examinateur |
| MME | BOURDON | Adeline | Maître de Conférences | Examinateur |
| M. | REMOND | Didier | Professeur des Universités | Directeur de thèse |

## Résumé

The requirement for a more compact solution about the electrical machines leads to a design trend of a higher rotational speed and a lighter mechanical structure. These modifications may bring some nonlinear vibrations and even cause the rotor-stator contact in the worst case. These vibration phenomena are mainly generated by the Unbalanced Magnetic Pull (UMP) inside of the machine due to the airgap eccentricity. In order to study this lateral vibration under the influence of different architectures, a multiphysics electric machine model with a strong electro-magneto-mechanical coupling is developed in this thesis by adding the interaction between the UMP and the rotor radial displacements to reinforce this fully coupling considered in both the radial and rotational movements. The proposed model is established based on the angular approach so that another novelty of this work lies in calculating the instantaneous angular speed of the motor shaft and therefore tackling the problems in non-stationary operating conditions. The mesh/nodal mixed permeance network is adopted to model the distorted magnetic field under both the rotor eccentricity and the mass eccentricity. This multiphysics model is validated by comparing with the finite element model in the quasi-static regime. Two traditional electrical motors (the cage induction motor and the permanent magnet synchronous motor) are chosen as examples to realize the proposed model. The physical characteristics about UMP and its frequency components associated with the input static eccentricity are investigated in the induction motor while the self-excited rotor vibration is identified in the waveform of UMP and the rotor center radial displacements together with the resonance peak generated by the mass unbalance excitation in the permanent magnet synchronous motor. The two models are finally employed respectively to study the influence of different mechanical structure and the effect of different winding configurations.