# 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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| **Candidat** | MME CUSSEAU Pauline |
| **Fonction** | Doctorant |
| **Laboratoire INSA** | LAMCOS |
| **Ecole Doctorale** | ED162 : MEGA |
| **Titre de la thèse** | « The role of polymer additives on the behavior of engine lubricants in the Elastohydrodynamic and Thin Film regimes: From rheology to tribology » |
| **Date et heure de soutenance** | 23/03/2018 à 9h30 |
| **Lieu de soutenance** | Amphithéâtre Emilie du Châtelet (Bibliothèque Marie Curie) (Villeurbanne) |

## Composition du Jury

| Civilité | Nom | Prénom | Grade / Qualité | Rôle |
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| MME | FERNANDEZ | Josefa | Professeur des Université | Rapporteur |
| M. | FILLON | Michel | Directeur de Recherche | Rapporteur |
| M. | CHASSENIEUX | Christophe | Professeur des Université | Examinateur |
| MME | MARTINIE | Laetitia | Maître de Conférences | Examinateur |
| M. | VERGNE | Philippe | Directeur de Recherche | Directeur de thèse |
| M. | PHILIPPON | David | Maître de Conférences | co Directeur de thèse |

## Résumé

The development of high-performance lubricants to reduce engine friction and consequently fuel consumption remains a major challenge for oil manufacturers. Viscosity Index Improvers (VII) are polymer additives used for decades to limit the dependency of the lubricant's viscosity on temperature, to maintain an acceptable hydrodynamic lubrication at high temperature, without experiencing excessive frictional and thermal losses at low temperature. This work focuses on understanding the role of VII in engine lubricants with the aim to bridge their tribological response with their rheological behavior. Simplified lubricants are studied, composed of various polymers of different molecular weights and conformations added to a mineral base oil.

In a first part, the viscosity-temperature-pressure dependence of these lubricants is investigated. Their rheological behavior is shown to result from mechanisms occurring at molecular scale, by considering the notions of solubility, hydrodynamic radii and conformation effects.

In a second part, the viscosity-shear stress dependence is discussed according to the polymers structure and predicted on a large range of temperatures and pressures through a conventional model. However, the strong assumptions behind this model lead us to propose a more appropriate relationship which takes into account the viscoelastic properties of the lubricants.

Finally, film thickness measurements are conducted to explore how the polymer addition affects the lubricant's response in the Elastohydrodynamic and Thin Film regimes. They are compared with analytical predictions based on the rheological models established previously. It is shown that i) there is a good agreement between predictions and measured film thicknesses in the EHD regime and ii) at lower thickness, i.e. in the Thin Film regime, some polymers show a critical thickness from which the film thickness significantly departs from the predictions. Several explanations are considered, among them the non-Newtonian behavior of the lubricants and the adsorption of polymers on the solid bodies.