

RÉPUBLIQUE ALGÉRIENNE DÉMOCRATIQUE ET POPULAIRE  
MINISTÈRE DE L'ENSEIGNEMENT SUPÉRIEUR ET DE LA RECHERCHE  
SCIENTIFIQUE

ÉCOLE NATIONALE POLYTECHNIQUE

Département d'Automatique



المدرسة الوطنية المتعددة التقنيات  
Ecole Nationale Polytechnique



# End of Studies Project

In view of obtaining the State Engineering Diploma in Automatic Control

---

Linear and Non-Linear Control Approaches Applied to  
Diesel And Dual-Fuel Engines

---

**Realized by:**

GASMI AKRAM

**Under the supervision of :**

D.BOUKHETALA ENP

M.BENBRAIKA ENP

**Composition of the jury :**

PRESIDENT: EM. BERKOUK ENP

EXAMINER: F. BOUDJEMA ENP

Presented and publicly defended on (02/07/2024)

ENP 2024



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Laboratoire de Commande des Processus

# Mémoire de Projet de Fin d'Etudes

En vue de l'obtention du Diplôme d'Ingénieur d'État en Automatique

---

Approches de Contrôle Linéaire et Non Linéaire Appliquées aux  
Moteurs Diesel et Bi-Carburant

---

Réalisé par:

GASMI AKRAM

Sous la direction de :

D.BOUKHETALA ENP

M.BENBRAIKA ENP

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# الملخص

يهدف هذا البحث إلى دراسة وتقييم تقنيات التحكم في محركات الديزل ومحركات الوقود المزدوج. يتم تقديم نظرة شاملة على تاريخ وتطور محركات الديزل، مع التركيز على مكونات عملية احتراق الوقود داخل هذه المحركات. بالإضافة إلى ذلك، يتم مناقشة المحرك النموذجي F4L912 ومواصفاته الرئيسية.

تم التطرق أيضًا إلى مفهوم محركات الوقود المزدوج (ديزل/غاز طبيعي)، وشرح كيفية تحويل محركات الديزل التقليدية للعمل بالوقود المزدوج، بما في ذلك نظام الحقن بالمزج والتحديات المرتبطة بذلك. الهدف الرئيسي من استخدام الوقود المزدوج هو تقليل الانبعاثات وتحسين كفاءة استهلاك الوقود، مع تقديم تحليلات لمزايا وعيوب هذه التقنية.

## الكلمات الرئيسية

محركات الديزل، محركات الوقود المزدوج، احتراق الوقود، تحويل المحركات، تقنيات التحكم، الانبعاثات، كفاءة الوقود.

## Résumé

Ce projet vise à étudier les techniques de contrôle pour gérer l'alimentation en énergie d'un moteur diesel converti en fonctionnement à double carburant utilisant le diesel et le gaz naturel. En se concentrant sur le moteur F4L912, l'étude explore l'intégration des systèmes de gaz naturel pour optimiser la combustion, améliorer l'efficacité énergétique et réduire les émissions. Les résultats visent à contribuer au développement de technologies de moteurs plus efficaces et respectueuses de l'environnement.

**Mots clés :** Moteur diesel-Système à double carburant-Gaz naturel-Efficacité énergétique-Contrôle intelligent-Optimisation de la combustion-Impact environnemental

## Abstract

This project investigates control techniques for managing the power supply of a diesel engine converted to dual-fuel operation using diesel and natural gas. Focusing on the F4L912 engine, the study explores the integration of natural gas systems to optimize combustion, improve fuel efficiency, and reduce emissions. The findings aim to contribute to the development of more efficient and environmentally friendly engine technologies.

**Keywords :** Diesel Engine Dual-Fuel System-Natural Gas-Fuel Efficiency-Intelligent Control-Combustion-Optimization-Environmental Impact

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*Thank you all for your invaluable contributions to my academic and professional development.*

# *Dedication*

*To my dear mother,  
To my dear father,  
To my brothers Salah, Ritedj,  
To my dear grandparents,  
To all my family and friends,*

*Akram*

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