

Contents

Abstract

Resumen

Resum

List of publications

Acknowledgments

Contents

List of Figures

List of Tables

List of Equations

List of symbols

Latin characters

Greek characters

Sub- and Superscripts

Acronyms

Introduction

- 1.1. Background
- 1.2. Motivation
- 1.3. Objectives
- 1.4. Methodology
- 1.5. Bibliography

Literature Review

- 2.1. Atmosphere simulation
 - 2.1.1. Testing facilities
 - 2.1.1.1 On-road tests
 - 2.1.1.2 Portable rolling benches
 - 2.1.1.3 Altimetric and climatic chambers
 - 2.1.1.4 Atmosphere simulators
 - 2.1.2. MEDAS validation
 - 2.1.3. Airstream moisturizing technologies
- 2.2. Effect of the atmospheric conditions on diesel engine
 - 2.2.1. Altitude
 - 2.2.1.1 Performance
 - 2.2.1.2 Pollutant Emissions
 - 2.2.2. Temperature
 - 2.2.2.1 Engine performance
 - 2.2.2.2 Engine out pollutant emissions
 - 2.2.3. Humidity

2.2.3.1 Engine performance

2.2.3.2 Pollutant emissions

2.3. 1D modeling

2.4. Bibliography

Altitude Simulator: MEDAS

3.1. Introduction

3.2. MEDAS enhancements by inductive procedures

3.2.1. MEDAS improvement: 2nd Generation

3.2.1.1 Hardware improvement

- a) 2 stage compression
- b) Exhaust line pressure loss
- c) Condensates extraction system
- d) Exhaust Cooler bypass

3.2.1.2 Control software improvement

- a) Pressure control
- b) Pressure step demand protection ramp
- c) Mechanical compressor map improvement
- d) Minimum mass flow control

3.2.2. Components safety strategies

3.2.2.1 Turbocharger oil

3.2.2.2 Pneumatic air and cooling water

3.2.2.3 Electric box temperature

3.2.2.4 Mechanical compressor oil health

3.2.3. Freezing ambient enhancement

3.2.4. Parallel connection configuration

3.3. MEDAS family development by deductive procedures

3.3.1. Layout design

3.3.2. Component selection

3.3.2.1 WG valve

3.3.2.2 Turbocharger

3.3.2.3 Exhaust coolers bypass valve

3.3.2.4 Mechanical compressor

3.3.3. Special components design

3.3.3.1 Exhaust coolers

- a) Preliminary 0D model
- b) 0D and CFD model
- c) Experimental campaign

3.3.3.2 Cyclonic separator

3.3.3.3 Piping geometry optimization

- 3.3.4. 1D model development
 - 3.3.4.1 Control strategies
 - a) Mass flow control
 - b) Pressure control
 - c) Mechanical compressor inlet temperature control
 - 3.3.4.2 Components modeling
 - a) Control valves
 - b) Mechanical compressor
 - c) Turbocharger
 - d) Exhaust heat exchanger
 - e) Cyclonic separator
 - 3.3.4.3 Pressure drop correlations
 - 3.3.4.4 Performance results
- 3.3.5. Prototype development
 - 3.3.5.1 Performance
 - a) Steady-state
 - b) Dynamic
 - 3.3.5.2 1D model validation

3.4. Bibliography

Atmosphere Simulator: MEDAS + MTM + MHM

- 4.1. Introduction
- 4.2. MTM development
 - 4.2.1. Layout
 - 4.2.2. Control strategies
 - 4.2.2.1 Pressure control
 - a) Base speed
 - b) Minimum pressure estimation
 - c) MEDAS pressure control extension
 - d) Temperature setpoint corrections
 - e) Humidity setpoint corrections
 - f) Summary of the pressure control
 - 4.2.2.2 Temperature control
 - a) TSP,MTM generation
 - Heat losses correction
 - Temperature setpoint corrections
 - Humidity setpoint corrections
 - Summary of TSP,MTM generation
 - b) Heater control
 - 4.2.2.3 Surge control

- 4.2.3. MTM + MEDAS Performance
 - 4.2.3.1 Steady-state
 - 4.2.3.2 Dynamic
- 4.3. MHM development
 - 4.3.1. Layout
 - 4.3.2. Bubbling water column development
 - 4.3.2.1 Equipment requirements
 - 4.3.2.2 CFD Methodology
 - a) Solver and Models
 - b) Computational Domain
 - c) Phase Interaction Models
 - 4.3.2.3 Prototype development
 - 4.3.2.4 Results and Validation
 - 4.3.3. Control strategies
 - 4.3.3.1 Humidity control
 - 4.3.3.2 Pressure control
 - 4.3.3.3 Temperature control
 - a) Heater control
 - b) TSP,MTM control
- 4.4. Atmosphere simulator performance
 - 4.4.1 Steady-state
 - 4.4.2 Dynamic
- 4.5. Application of the Atmosphere Simulator on RDE+ procedures
- 4.6. Bibliography

Application on a Diesel engine

- 5.1. Introduction
- 5.2. Test bench description
- 5.3. Water injection on the intake line
- 5.4. Ambient conditions effect
 - 5.4.1. Effect of the pressure
 - 5.4.2. Effect of the temperature
 - 5.4.3. Effect of the humidity
- 5.5. Bibliography

Conclusions and future works

- 6.1. Main conclusions
 - 6.1.1. Atmosphere simulator performance
 - 6.1.2. 1D modeling
 - 6.1.2.1 Components
 - 6.1.2.2 Pressure-drop correlations

- 6.1.3. Effect of the ambient conditions on a diesel engine
 - 6.1.3.1 Altitude
 - 6.1.3.2 Temperature
 - 6.1.3.3 Humidity
- 6.1.4. Components development
 - 6.1.4.1 Cyclonic separator
 - 6.1.4.2 Exhaust cooler
 - 6.1.4.3 Bubble water-column
- 6.2. Conclusions on the broader research context
- 6.3. Future works
 - 6.3.1. Atmosphere simulator
 - 6.3.1.1 Control redesign
 - 6.3.1.2 1D Modelling
 - 6.3.2. Effect of the humidity on a diesel combustion process
- 6.4. Bibliography

Global Bibliography