DIN - DEPARTMENT OF INDUSTRIAL ENGINEERING

PhD Course in Mechanics and Advanced Engineering Sciences (DIMSAI)

PHD STUDENT POSTER - AY *2016/2017* **Curriculum number *II*** **Cycle *XXXII***

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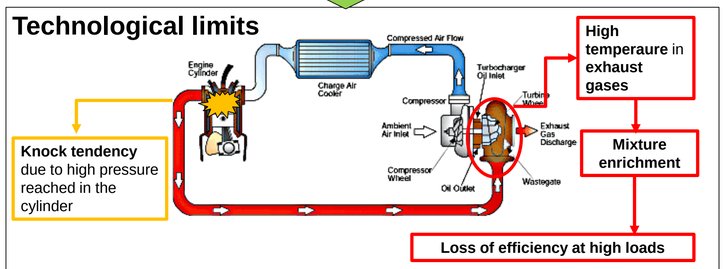
EXPERIMENTAL STUDY OF WATER INJECTION FOR ADVANCED SI ENGINES

Introduction

The design of new **Spark Ignition** engines has recently developed several technologies to improve efficiency:

- Downsizing
- Turbocharging

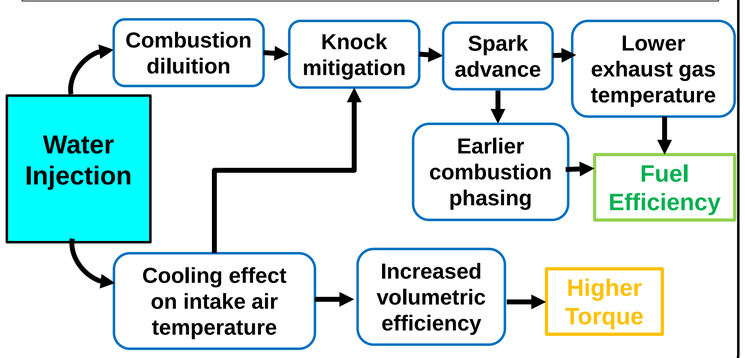
Technological limits



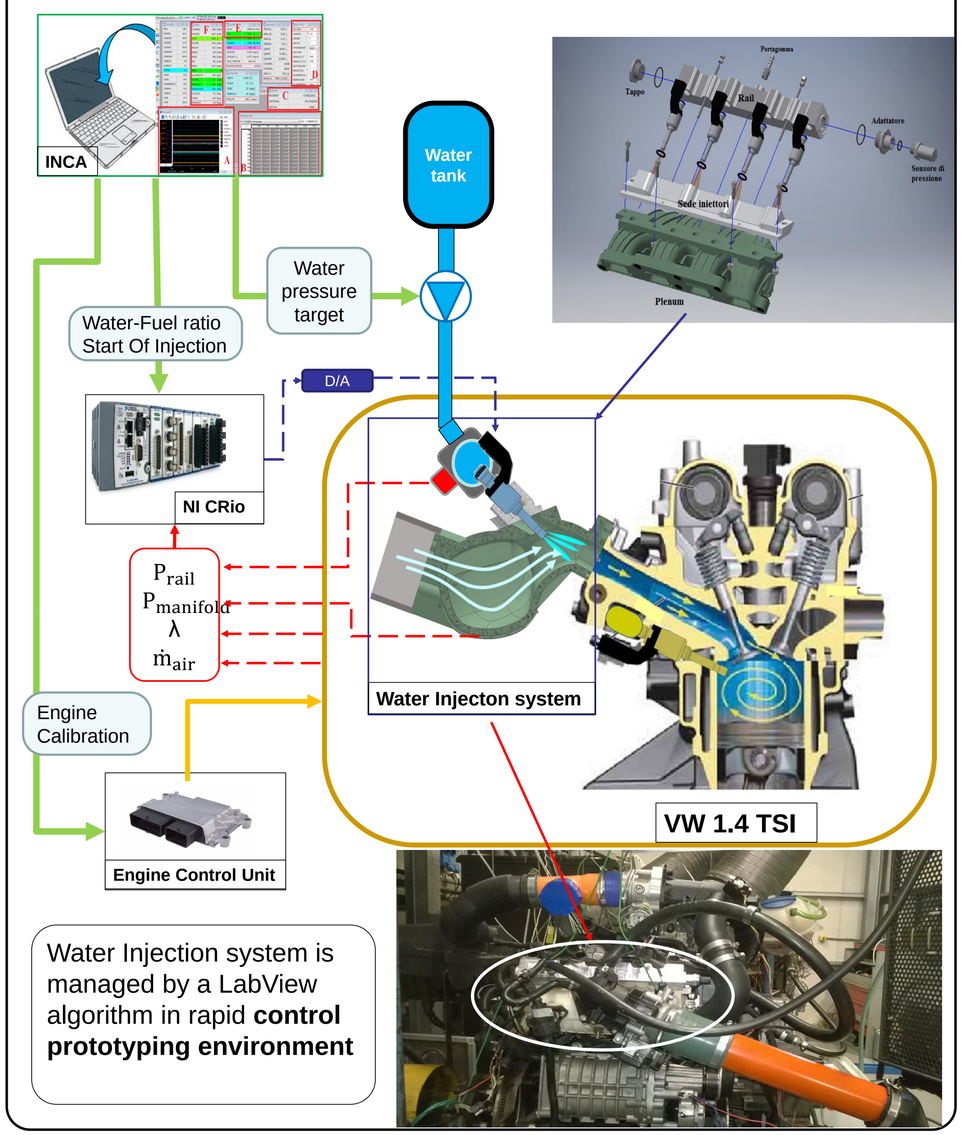
Due to new tighter CO_2 and emissions limits set by legislation automotive manufacturers are forced to explore new concepts for advanced SI engines.

Water Injection concept

Use of **high latent heat of vaporization of water** to reduce gas temperatures before combustion. Furthermore the water **vapor acts as a diluent** in the combustion process mitigating significantly the knock tendency.



Experimental Set-up



Water Injection system is managed by a LabView algorithm in rapid **control prototyping environment**

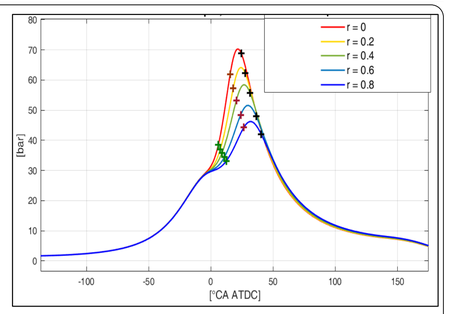
Post-processing data

Engine speed	Manifold pressure	AFR	Water-Fuel ratio (r)
3000	1500mbar	1	0:0.8

In-cylinder pressure
SA fixed at 13CA BTDC

The increase of water fraction leads to a reduction of maximum peak and shifts the MFB50 (red crosses) to retarded phase.

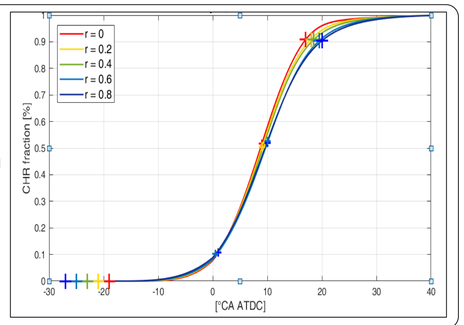
The overall combustion time is visibly dilated



Cumulative Heat Release
MFB50 fixed at 10°ATDC

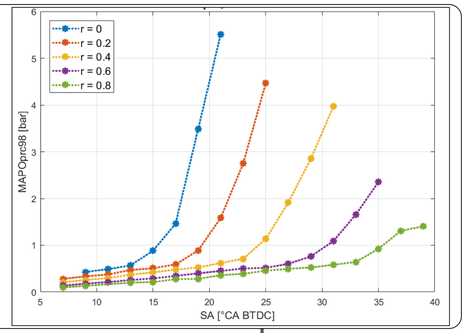
Under the same MFB50 phasing conditions the time extension is clearly focused on the first part of combustion.

The extension is probably related to dilution caused by the water vapor.



Knock Index
with SA sweeps

The water fraction strongly mitigates knock tendency, allowing to operate at the minimum brake specific fuel consumption in every load condition.



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