University of Brighton, **Advanced Engineering Centre**

Overview of Group Research and the Novel

Recuperated Split Cycle Engine

Mr Simon Harvey, Mr Firmansyah Firmansyah, Dr Konstantina Vogiatzaki, Dr Rob Morgan



ICE Thermal Efficiency Spoke



Research Council



University of Brighton

Advanced Engineering Centre

Motivation





- 1. Engine Level
- Cycle LevelCFD of full engine





1. Engine Level	2. Fuel Air Mixture in Extreme Conditions
Cycle LevelCFD of full engine	



1. Engine Level	2. Fuel Air Mixture in Extreme Conditions	3. Multiphase Combustion
 Cycle Level CFD of full engine 		

Conventional Thermodynamic Cycle Limitations



Emissions Limitations

- Ideal Combustion
 - $2 C_{16}H_{34} + 49 O_2 \rightarrow 32 CO_2 + 34 H_2O + energy$
- Real Combustion
 - Fuel + Air = Products + Energy
- Low Temperature Combustion • $k = A \cdot e^{-\frac{E_a}{R \cdot T}}$
 - Just enough energy to start a reaction
 - Not too high localised maximum temperatures during combustion (NOx formation ~ 2200K)



Novel Combustion Technologies and Engine Concepts

- LTC Technology
 - HCCI + Spinoffs (RCCI, SCCI, etc.)
- Novel Engine Concepts
 - Over expansion cycles
 - Five Stroke
 - Double expansion compression
 - Split Cycle
 - Scuderi engine
 - Aumet Z engine
- Recuperated Split cycle (UoB)



Perfectly Stirred Reactor Model

Question 1: What is the role of the fuel?

Perfectly Stirred Reactor Model

Confidential

Ref: F. Khalid, S. Harvey, F. Firmansyah, R. Morgan, K. Vogiatzaki, A. Atkins, D. Mason, M. Heikal, Towards zero emission engines through the adoption of combustion lead engine design realised using a split cycle topology, will appear at the Proceedings of the Conference on Thermo-and Fluid Dynamic Processes in Direct Injection Engines (THIESEL) 2018

Recuperated Split Cycle Engine at UoB

Question 2: What is the role of the engine architecture?

Recuperated Split Cycle Engine at UoB





Recuperated Split Cycle Engine at UoB



Flow into a large volume – fixed geometry, varying pressure ratio across valve

Question 3: What is the role of injection in the fuel air mixing?

Flow into a large volume – fixed geometry, varying pressure ratio across valve

Confidential

Ref: F. Khalid, S. Harvey, F. Firmansyah, R. Morgan, K. Vogiatzaki, A. Atkins, D. Mason, M. Heikal, Towards zero emission engines through the adoption of combustion lead engine design realised using a split cycle topology, will appear at the Proceedings of the Conference on Thermo-and Fluid Dynamic Processes in Direct Injection Engines (THIESEL) 2018

Flow into a large volume – fixed geometry, varying pressure ratio across valve

Confidential