A QUASI-DISCRETE MODEL FOR MULTI-COMPONENT FUELS

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The Sir Harry Ricardo Laboratories (SHRL) - Centre for Automotive Engineering

1st meeting

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University of Brighton

Outline

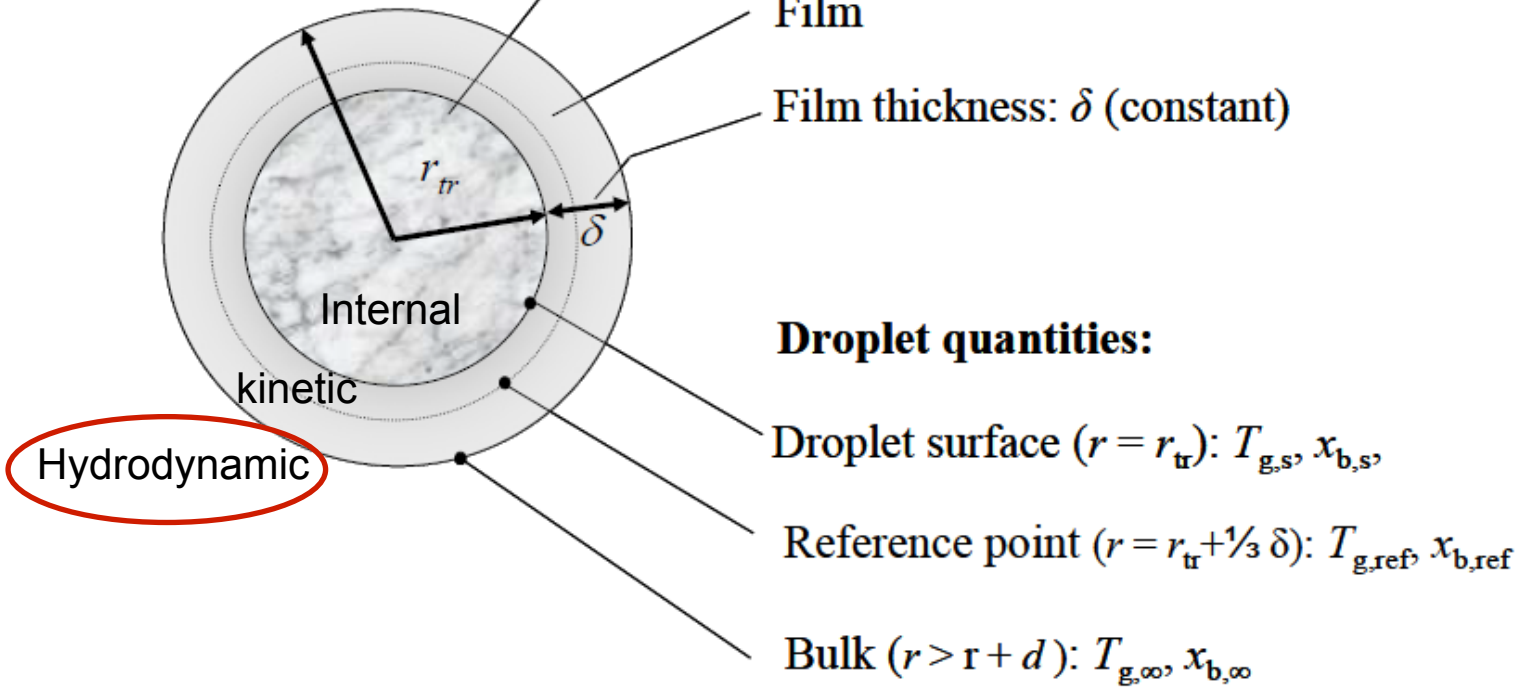
- General background
- Research proposal
- Concluding remarks

Processes in the combustion chamber of an IC engine

- Liquid fuel jet break-up
- Droplet break-up
- Heating of multi-component droplets
- Evaporation of multi-component droplets
- Ignition and combustion

Droplet Film Layers

Heating and evaporation take place simultaneously



Aim

To develop a model for automotive fuel droplet heating and evaporation suitable for implementation into computational fluid dynamics (CFD) codes.

Previously Developed Models

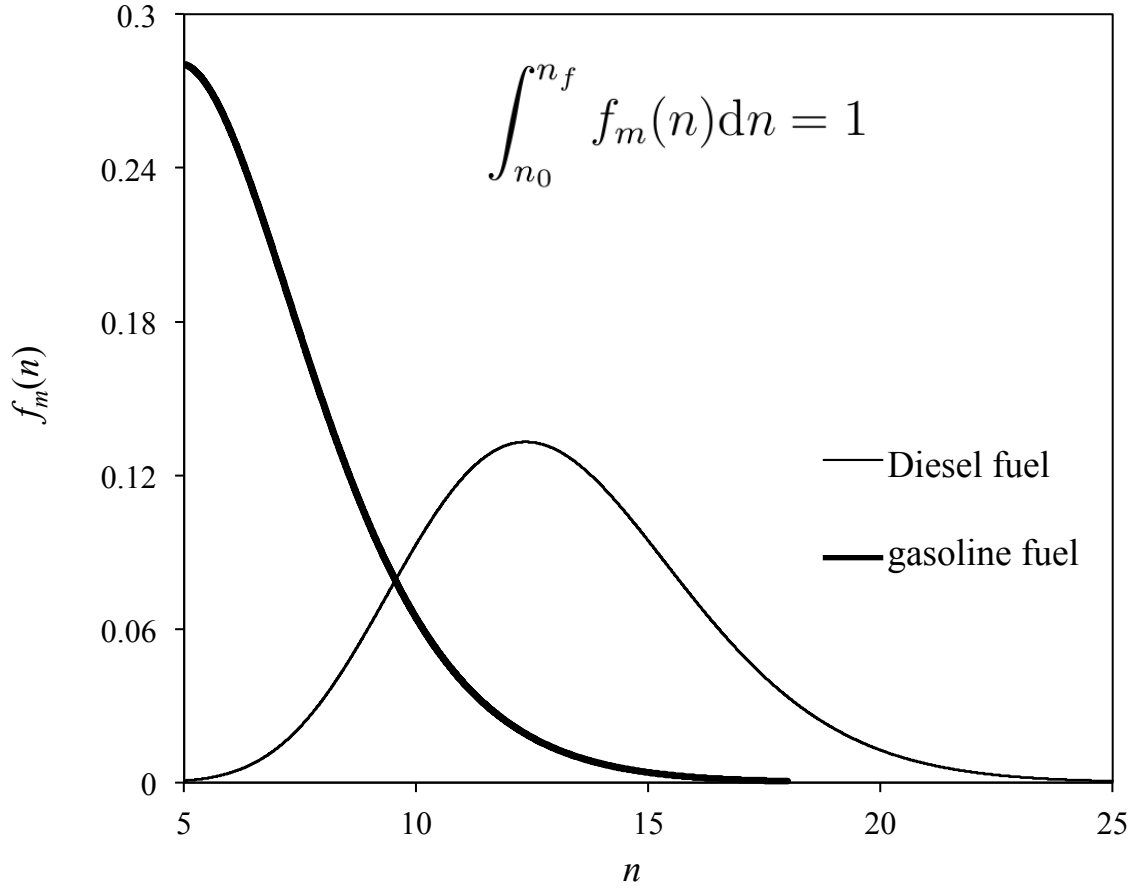
- A simplified model for bi-component droplets
- Effect of moving boundary
- Quasi-discrete model (n-Alkanes only)

Quasi-Discrete Model

- Quasi-discrete model is applicable to modelling droplets with a large number of components
- The model is based on replacing the large number of actual components with a small number of quasi-components
- These quasi-components are treated as actual components in this model, taking into account the diffusion of quasi-components in droplets

Mass Distribution of Diesel Components

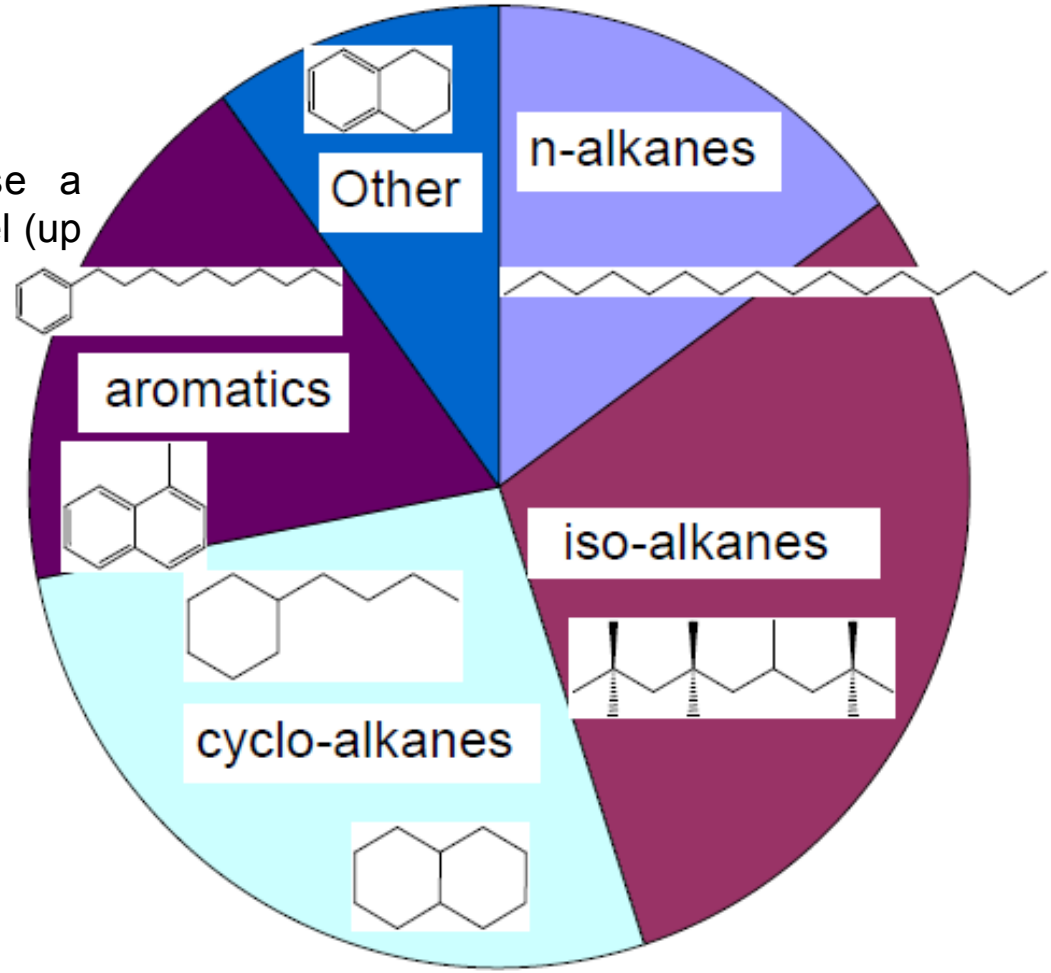
Typical example of Diesel and Gasoline distribution function



From: Sazhin S.S., Elwardany A.E., Sazhina E.M., Heikal M.R. (2011), *A quasi-discrete model for heating and evaporation of complex multicomponent hydrocarbons fuel droplets,* IJHMT, 54, 4325-4332.

Real Diesel Fuel Mixture

*Aromatics comprise a large fraction of diesel (up to ~35% on average)



*Pitz, W.J. and Mueller, C.J. (2009) Recent Progress in the Development of Diesel Surrogate Fuels. Progress in Energy and Combustion Science. LLNL-JRNL-421260

Concentration of Components in Gasoline

Typical example of Gasoline distribution composition at 25 C

	Gasoline		Surrogate★
iso-Alkanes	42.3%		57%
n-Alkanes	9.5%	68%	16%
Cyclo-alkanes	16%		–
Aromatics	26.4%		23%
Olefins	4.7%		4%
H/C	1.869		1.925
MON	82.7		83 (estimated)
RON	91		91 (estimated)

RON: Research Octane Number; MON: Motor Octane Number

★ Kukkadapu, G., Kumar, K., Sung, C-J, Mehl, M. and Pitz, W.J. (2012) Experimental and Surrogate Modeling Study of Gasoline Ignition in a Rapid Compression Machine. Comb. & Flame 159, 3066–3078.

Proposed Plan

- Investigation in feasibility of generalising the QD model for very large numbers of components in multi-component fuels (realistic automotive fuels)
- Application of the QD model to a wide range of automotive fuels, including bio-fuels.
- Implementation of the (unique) modified QD model into a commercial CFD code (e.g. FLUENT)

Thank you!

Your Comments would be highly appreciated..

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