



CCGEx

Competence Center Gas Exchange – KTH

CCGEx 2015 Research Day

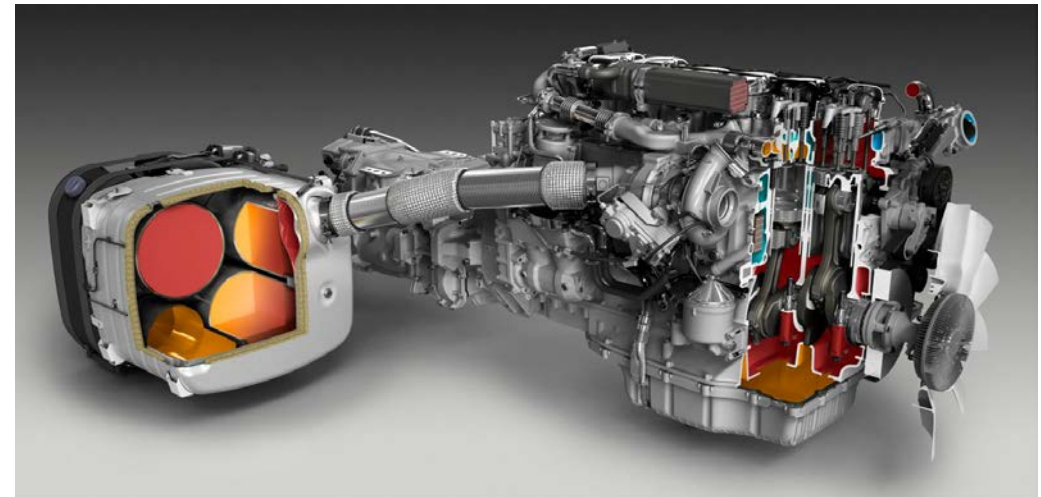
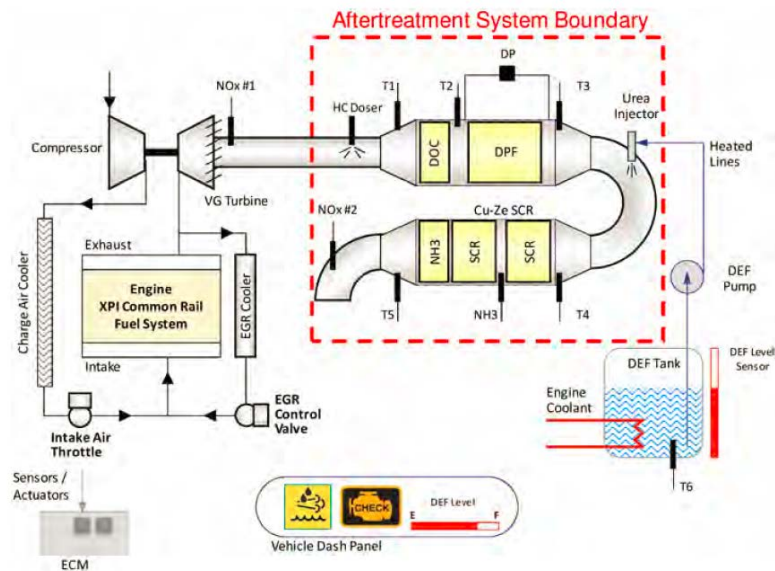
Exhaust Aftertreatment

2015-11-12, Mikael Karlsson

Exhaust Aftertreatment: CCGEx view

Scope:

Fluid mechanics, heat transfer, acoustics but not catalysis downstream of the turbine
 Interaction with engine control/strategy



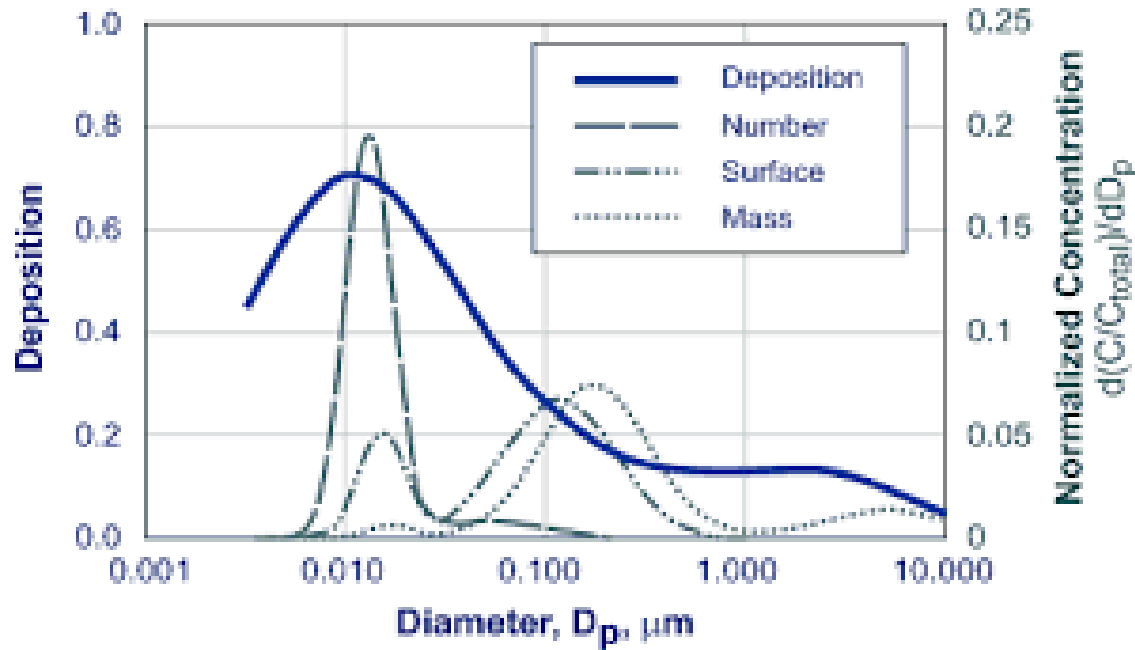


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Since last year - overview

- Research area initiated.
 - Go ahead from the Board in March 2015
 - First projects identified and started
 - Particle characterization and agglomeration (PCA)
 - Injection and transport of Urea-Water-Solution in automotive SCR systems (SCR)
 - Industry reference group and update meetings established
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PCA: Motivation



- Health effects (will be reflected in legislation)
- Passive targets as GPFs and DPFs increase fuel consumption and cost
- Evolution of size and distribution along the exhaust line unknown.



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PCA: Project setup

- Involves all three academic departments
 - 1 Ph.D. student at ICE: Characterization measurements in exhaust lines for various conditions and simplified modelling
 - 1 Ph.D. Student joint Mek/MWL. Advanced numeric modelling of hydrodynamic and acoustic forcing on particles.
 - Close interaction between the two
- Close interaction with industry
 - Internships and measurements
- Collaboration with other particle grouping projects
 - Sorting of particles in mean flow using acoustics (KTH project)
 - Also includes fundamental modelling studies (e.g. Non-continuum)
 - Hydrodynamic grouping of particles (Ben Gurion University Israel)





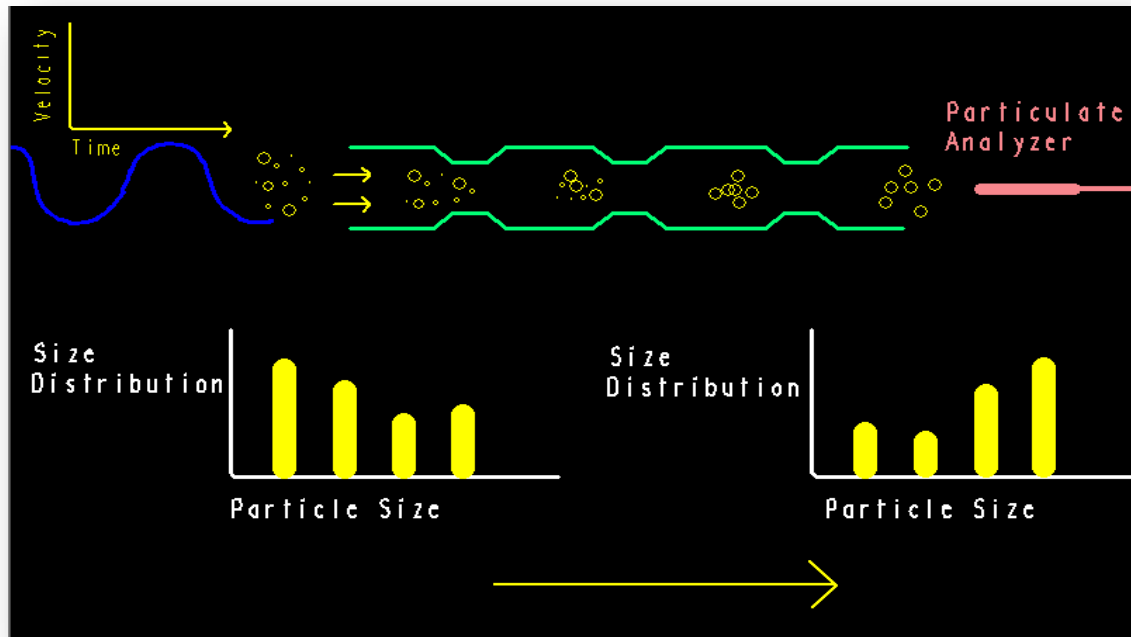
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PCA – Long term planning

Research activity	Q3-15	Q4-15	Q1-16	Q2-16	Q3-16	Q4-16	Q1-17	Q2-17	Q3-17	Q4-17	Q1-18	Q2-18	Q3-18	Q4-18	Q1-19	Q2-19	Q3-19	
Particle characterization and agglomeration																		
Setup and validation of particle measurement system in engine cell	█																	
Internship Volvo Cars - engine control and 1D modelling		█																
GT-Power model of engine		█																
Implement available 1D model			█															
Particle distribution EN228-fuel, stationary-cycle			█	█														
Particle distribution EN228-fuel, stationary-cycle with forced particle grouping				█	█													
Particle distribution at transients					█	█	█	█	█									
Particle distribution fuel quality (optional, can be shifted in time)									█	█	█	█	█					
LES of engine installation to be tested	█																	
Particle grouping theoretical framework	█	█	█	█	█	█	█	█	█									
Simulation strategy																		
Full	█	█	█	█	█	█	█	█	█									
Reduced	█	█	█	█	█	█	█	█	█									
Identify validation cases, published and propose measurements			█	█	█													
Lab scale validation measurements					█	█	█	█	█									
Lic. Preparation and write up								█	█									
Internship: Concept development EAT									█	█								
Concept development - particle grouping. Simulation and actual application - Loop 1										█	█	█						
Validation measurements on engine particle grouping - Loop1												█	█					
Concept development - particle grouping. Simulation and actual application - Loop 2 (active control?)													█	█	█			
Validation measurements on engine particle grouping - Loop2 (active control?)															█	█		
Manning																		
	Resource		Department		Supervisor													
	Ph.D Student		ICE		A. Hultquist													
	Ph.D Student		MWL/Mech		M. Åbom/M. Mihaescu													
	Post-Doc		Mech		M. Mihaescu													
TBD	Thesis workers, industry in-kind, seniors, etc																	

PCA: Example hydrodynamic agglomeration

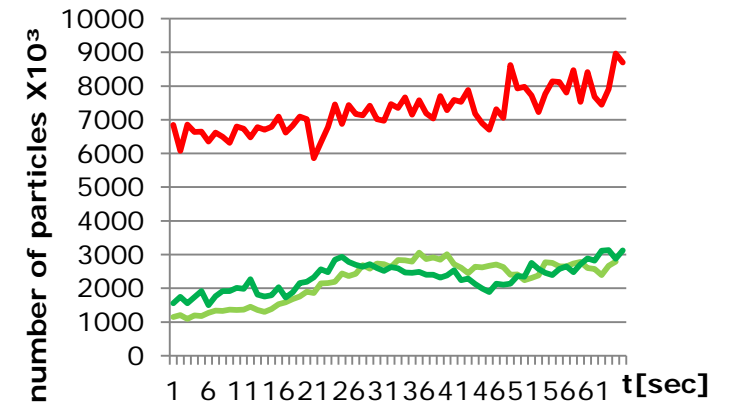
From project partner D. Katochevski (Ben Gurion Uni., Israel).



Principle



Real life



- regular pipe
- pipe 2
- pipe 3

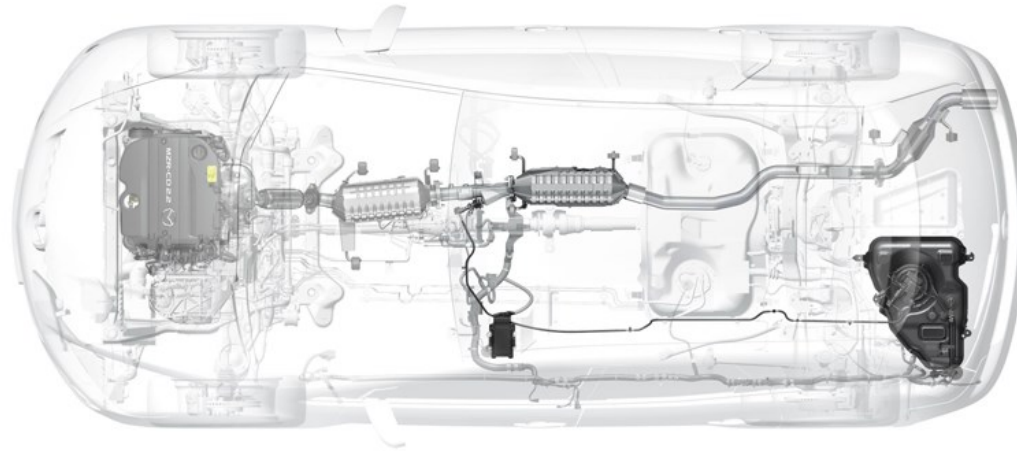
PCA: Example Acoustic sorting

From: Ramins J Imami, Acoustic separation of sub- micron particles in gaseous flows. Lic. thesis KTH 2015



Mean flow in narrow channel. High amplitude, high frequency excitation. Here 75 kHz

SCR: Motivation



- THE deNO_x-technology
 - Although in production for years for commercial vehicles fundamental understanding is missing
 - To reach the full potential of the technology optimization of the injection and transport of the UWS is vital.
 - Important next step is a system view where SCR is one component
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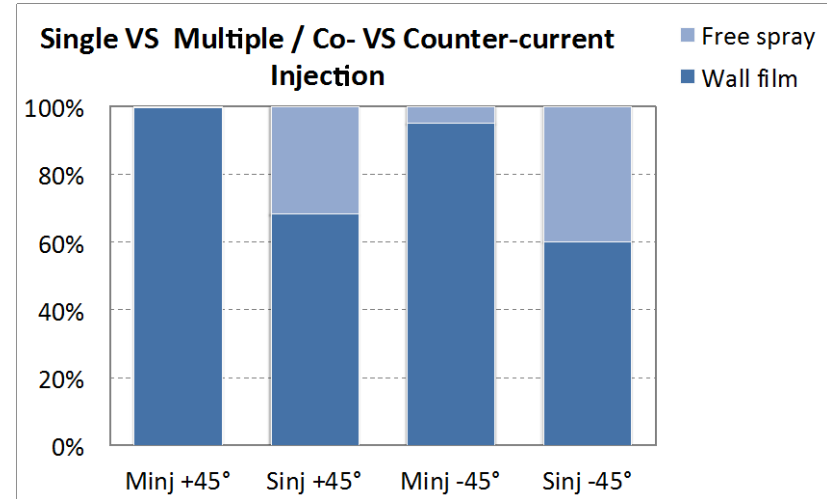
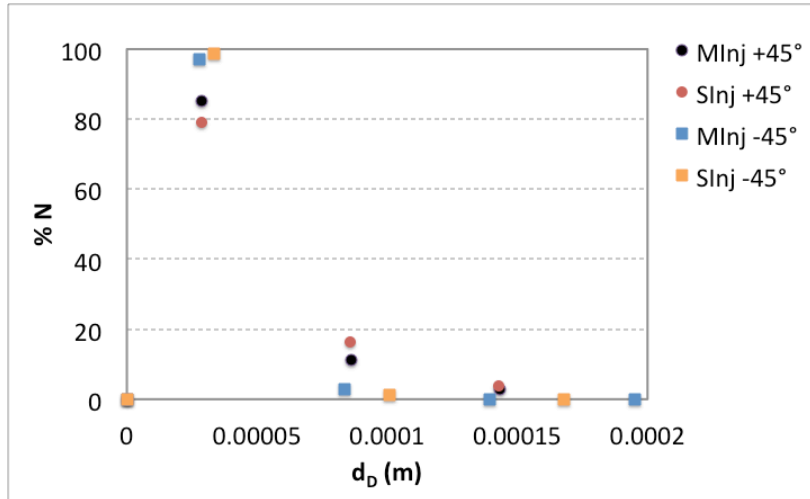
SCR: Project setup

- Prestudy to identify potential for improvement in present tools and understanding. Basis for further applications (internally and externally)
- Carried out by researcher at Mech (Mireia Altimira)
- Industry provides basic framework which serve as base for a parameter study.
- Associated project: experimental characterization of UWS-sprays.

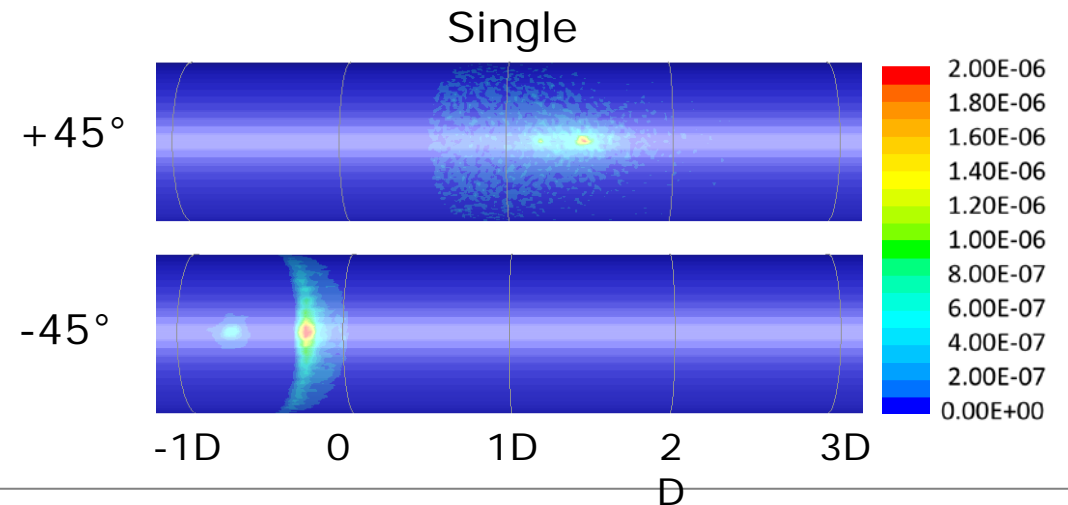
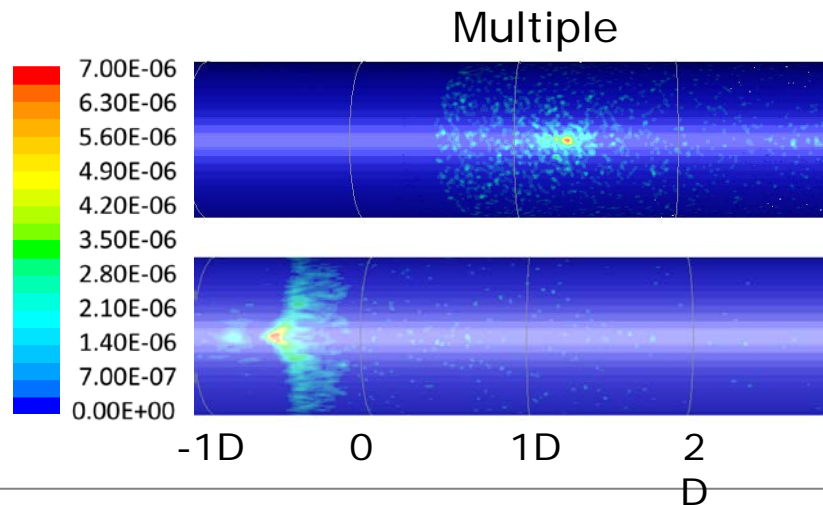


SCR – Example result

- Droplet distribution



- Wall film thickness (m)





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Until next year...

- Particle grouping project well established and up to speed
 - First results and publications from EAT
 - Applications for external funding
 - Work shops to identify further relevant research topics within the scope of EAT
 - Attract new partners to the centre
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