KTH ROYAL INSTITUTE
OF TECHNOLOGY

Dynamic Exhaust Valve Flow 1-D Modelling during Blowdown Conditions

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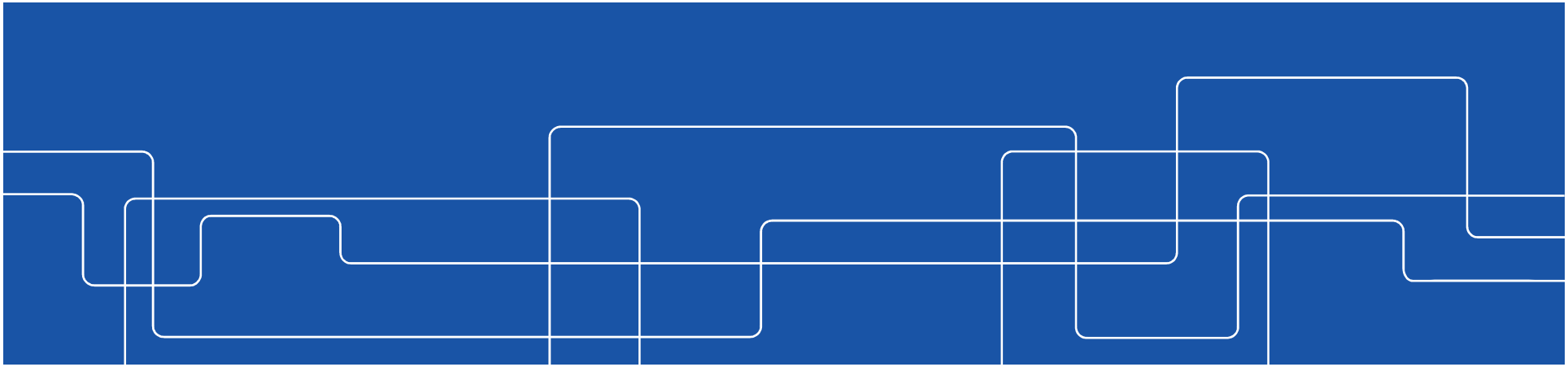
11.10.2018, CCGEx – Research Day

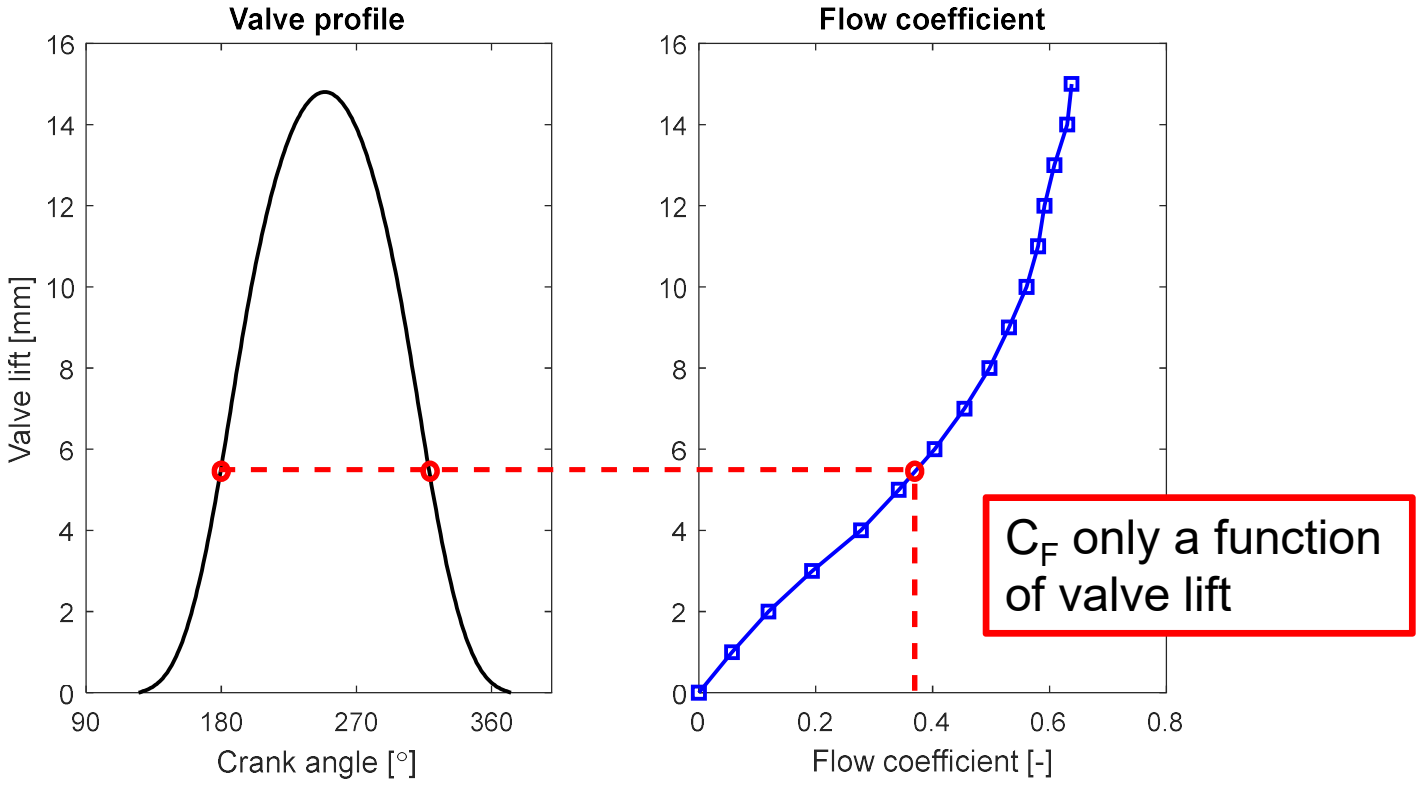


Project

- Valve strategies and exhaust pulse utilization
- 1-D GT-Power
- Engine experiments

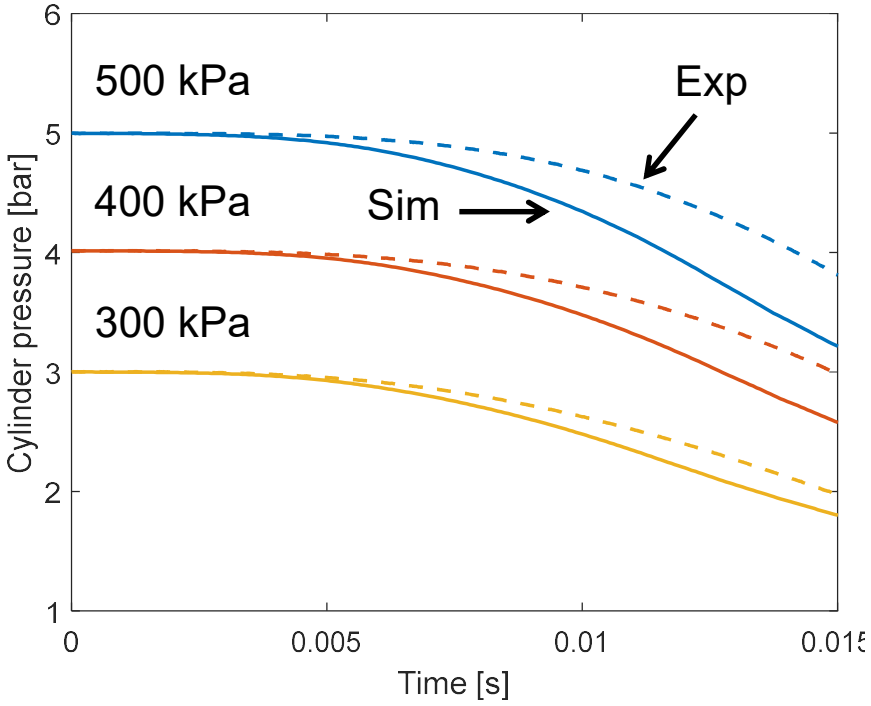
Valve flow coefficient

- 1D flow: quasi-steady assumption

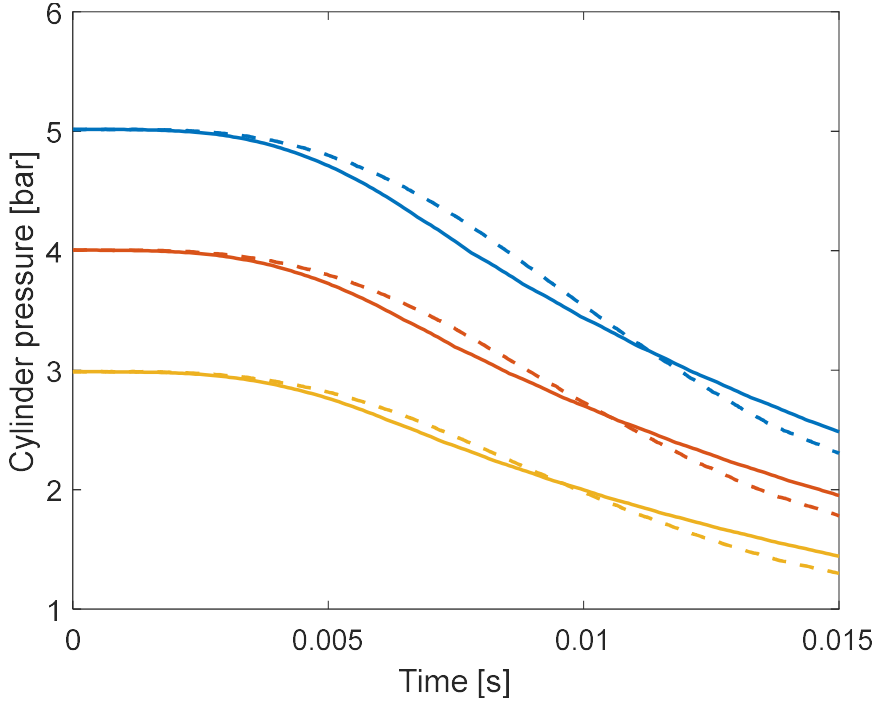


Simulation vs Experiments

800 rpm



1350 rpm

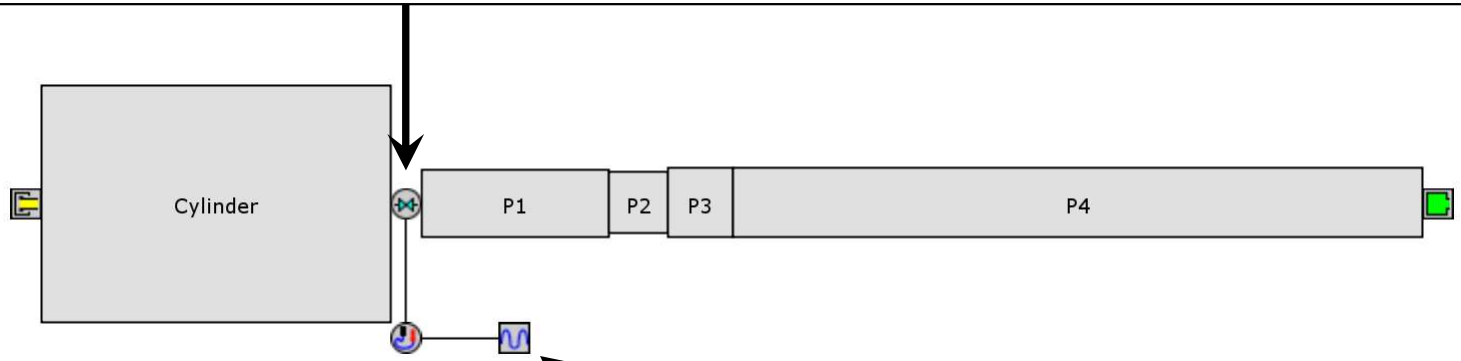


- QS valve flow over predicts the rate of cylinder emptying
- C_F function of valve opening speed and initial cylinder pressure

GT-Power model

- Replicate the experimental conditions
  - Initial cylinder pressure
  - Volumes and pipe dimensions

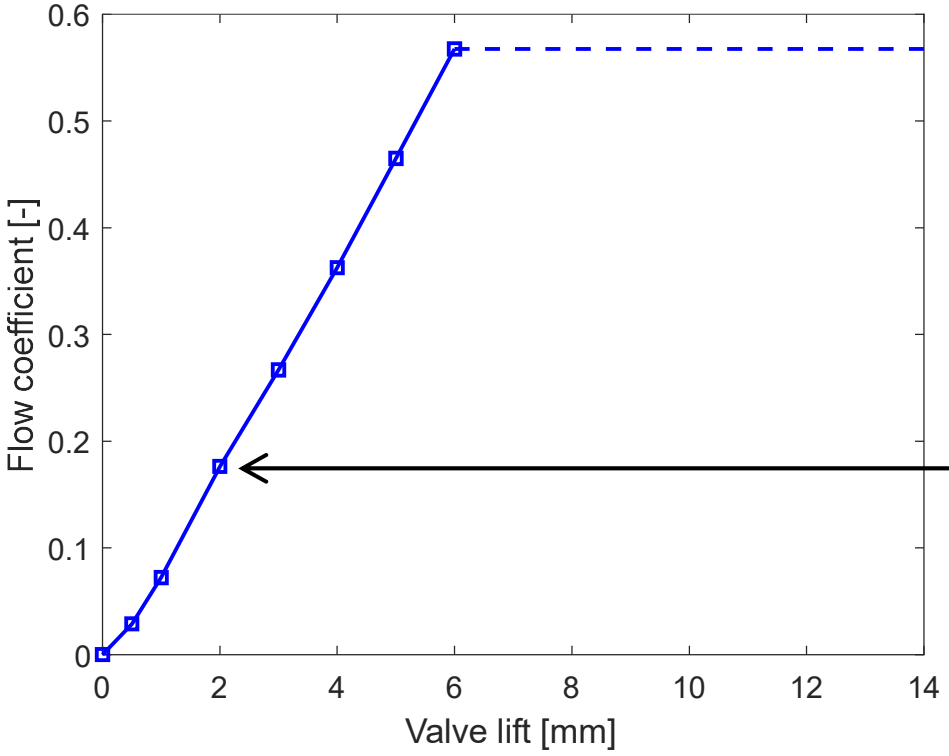
Valve object: Steady-flow C_F from the same setup



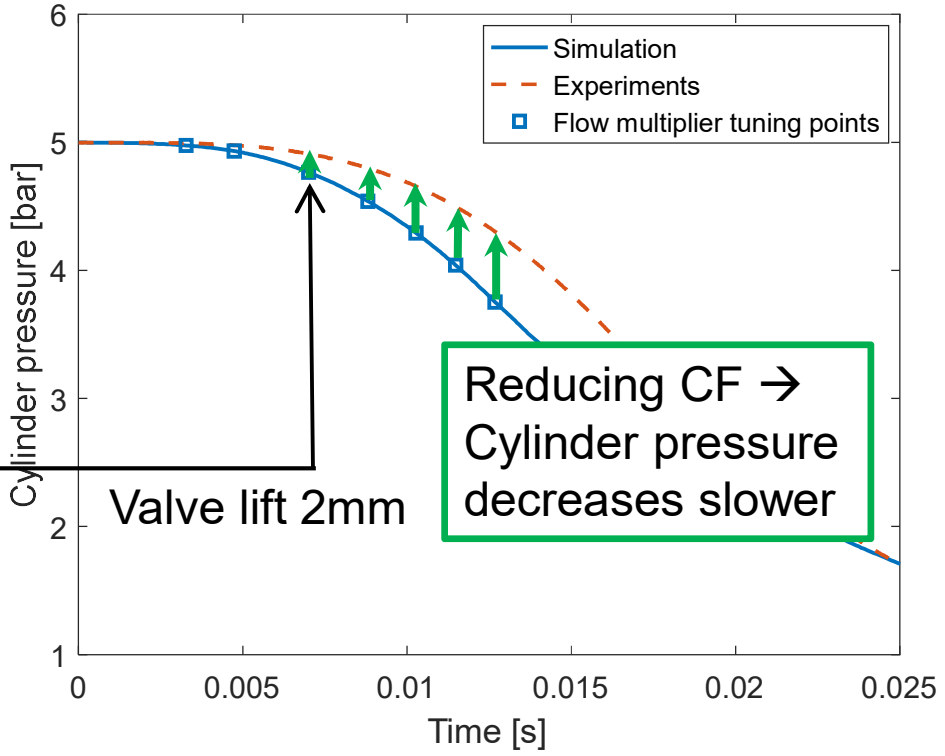
Measured valve profile imposed

Model tuning

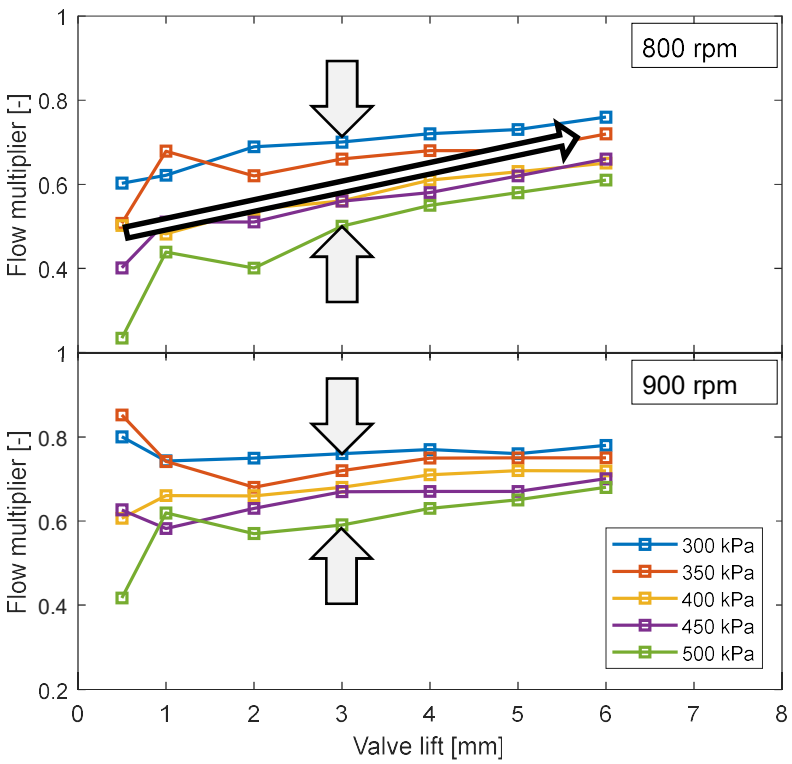
Steady-flow valve flow coefficients
(Choked flow conditions)

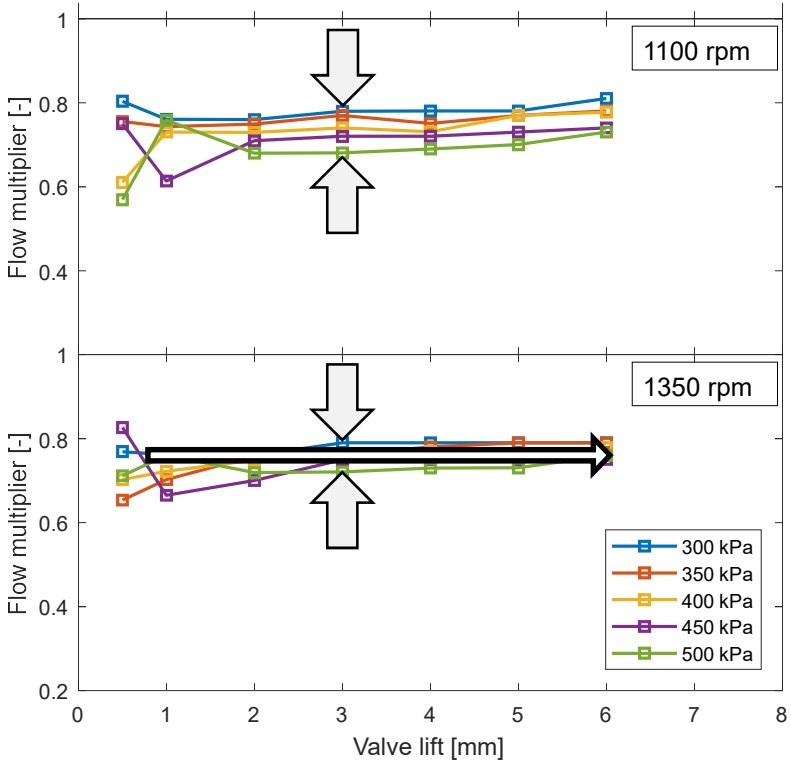


Cylinder emptying



Flow multiplier (fraction of steady-flow C_F)

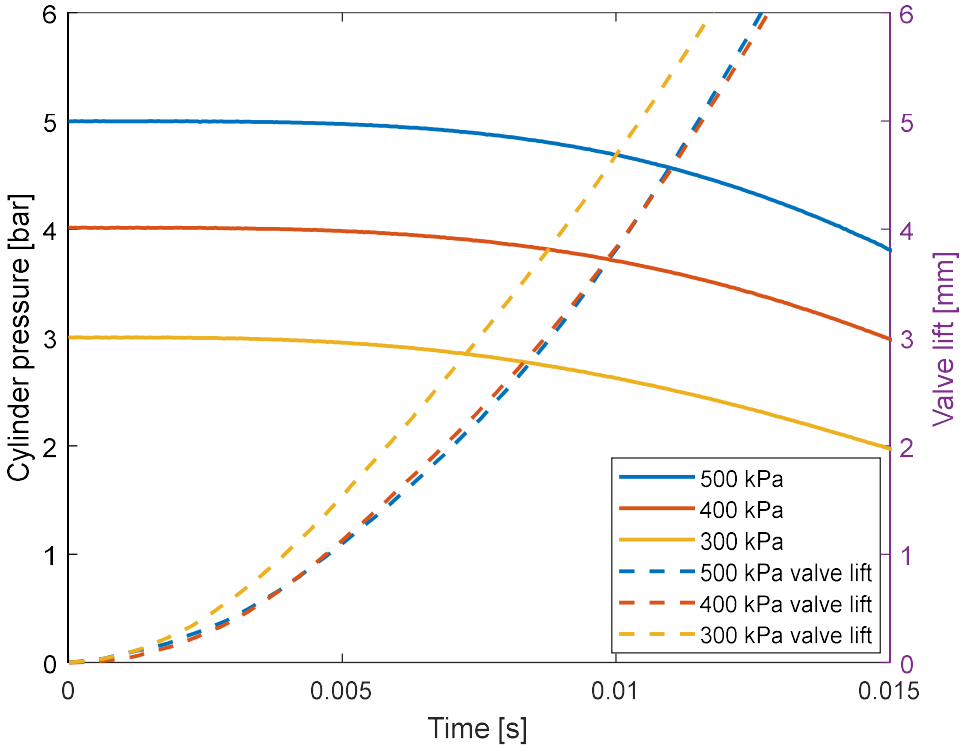




- Influence of initial pressure reduces with valve speed
- Influence of valve lift reduces with valve speed

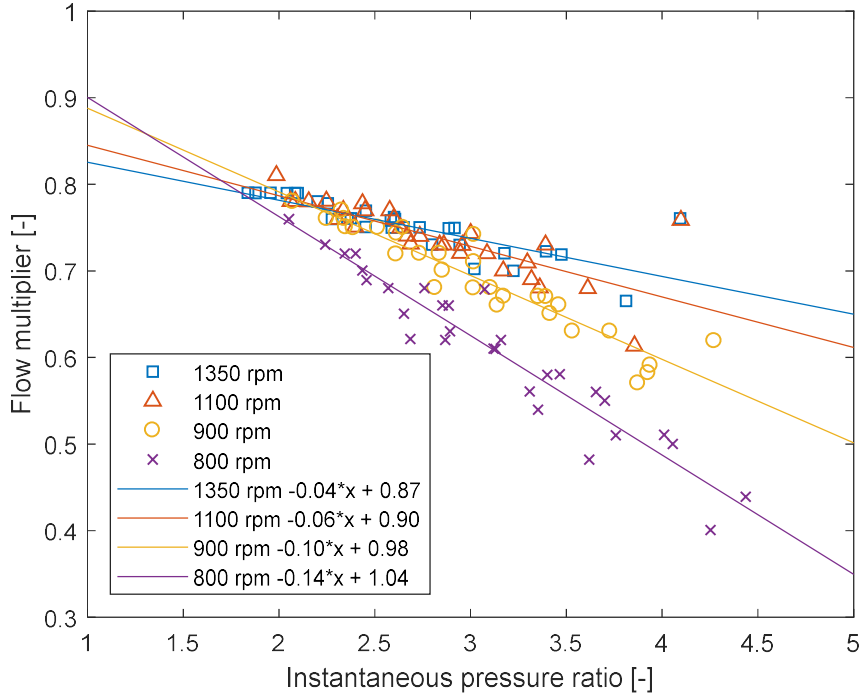
Flow multiplier

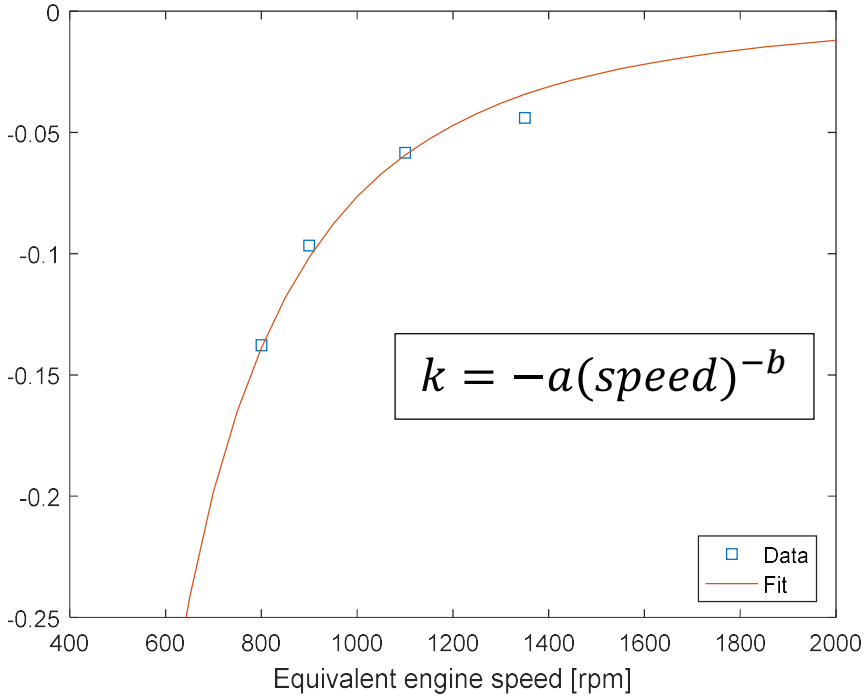
- At the same valve lift, the instantaneous pressure ratio is different for each test case



Flow multiplier model

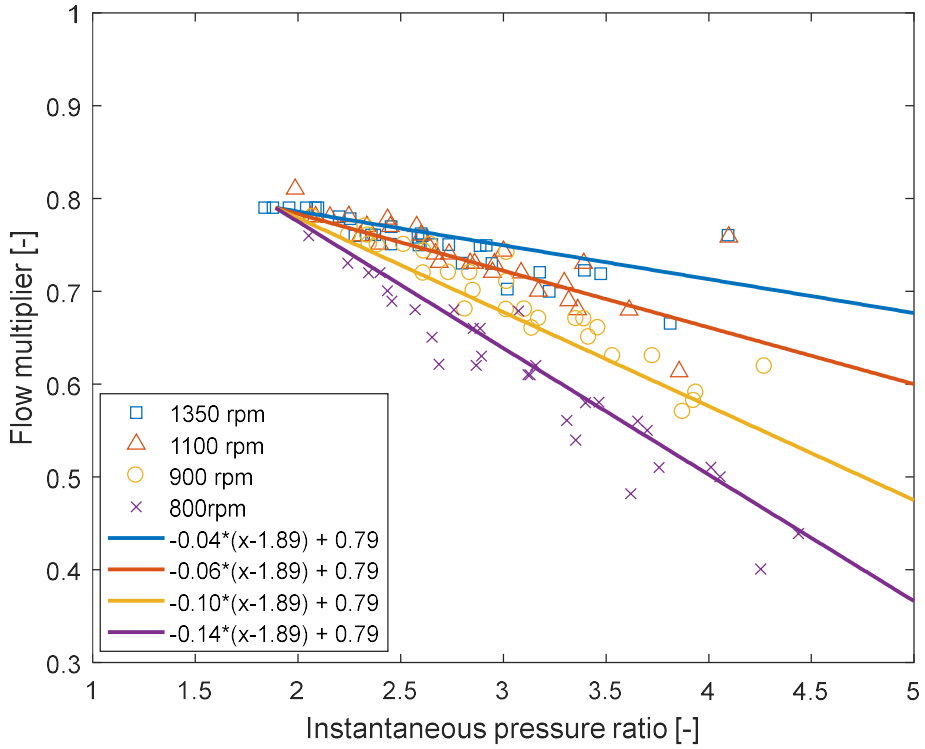
- GTP → Flow multiplier & instantaneous PR at a given lift
- Plot all initial pressures together





Final model

- Dependent on engine speed and pressure ratio
- Origin point (x0, y0) = (1.89, 0.79)



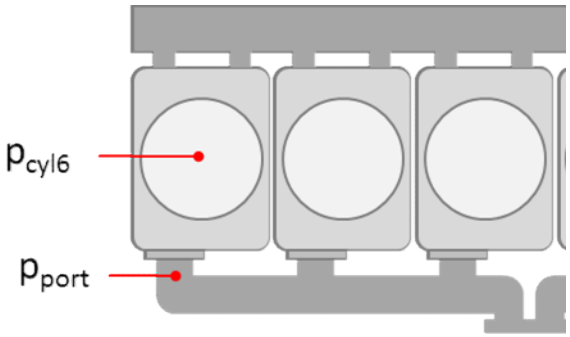
$$k = -a(speed)^{-b}$$

$$y = k(PR - x0) + y0$$

Future Work

- Implementing flow multiplier model in a GT-Power engine model to investigate impact on performance

- Engine test to measure valve flow through fast cylinder pressure and exhaust port measurement



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CC GEx

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