Simultaneous Reduction of Pressure Rise Rate and Emissions in a CI Engine using Binary Fuel Blends

Background

- Premixed charge compression ignition (PCCI) using early DI suffers from high pressure rise rate
- As demonstrated by LIF images shown below, a binary fuel blend can provide a mixture in which two components are stratified
- Binary fuel blends have a potential to suppress pressure rise rate in PCCI operation

Experimental Condition

- The experiments were performed in a single cylinder CI engine equipped with common-rail system
- Oxygen concentration and direct injection timing were set as experimental parameters
- Fuels tested were binary fuel blends of i-octane and n-tridecane and mixing fractions were changed

Multi-component Model

- developed in Doshisha Univ. based on KIVA3V (SAE Paper 2003-01-1838)
- employed Peng-Robinson EOS to estimate equilibrium phase composition with taking into account high pressure effect and ambient air dissolved into droplets
- employed a combination of SHELL ignition model and single-step oxidation reaction

Results

- The \( (dp/d\theta)_{max} \) of binary fuel blend is lower than that of pure component if compared at same condition
- The reduction of the \( (dp/d\theta)_{max} \) can be attributed to the fact that the two components have different local vapor concentration, causing spatial-temporal difference in combustion phasing
- Binary fuel blends are capable of reducing emissions while keeping the lower \( (dp/d\theta)_{max} \)