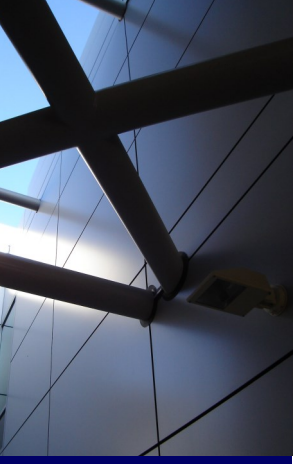

MECHANICAL ENGINEERING
DISSERTATION DEFENSE

The Department of Mechanical Engineering presents:

The Ph.D. Dissertation Defense of

Yue Lin

Monday, September 17, 2018, 3pm in Bourns Hall A265

Connecting physical metrics of ambient particles to exposure: Characterization of ambient particle metrics and correlations with lung deposited particle mass

Doctor of Philosophy, Graduate Program in Mechanical Engineering
University of California, Riverside, September 2018
Dr. Heejung Jung, Chairperson

The public raises concerns about the exposure to particulate matter (PM) which has been strongly associated with illness and mortality. It is a decades-old debate to determine metric(s) that represent (or correlate) exposure and/or adverse health effect.

First, the study focused on characterizing physical properties of particles namely particle spectra, particle effective density, BC and active surface area along with chemical characterization using AMS in Riverside, CA over 4 periods during 2015 – 2016. Size-resolved effective densities of ambient aerosols were determined using the DMA-CPMA. A catalytic stripper (CS) was used alternately to remove the volatile fraction of aerosol before density measurements. Size-resolved diurnal trend of ambient particles in different seasons is reported. The study provides an update to the aerosol density profiles of a well-known receptor site (Riverside, CA) and investigates the transformation of particles in different seasons. Second, the effective density profiles were used to estimate the respiratory system-deposited ambient particle mass according to lung deposition fraction curve reported by ICRP (1994). Correlations with PM dose (i.e. calculated respiratory system deposited particle mass) and particle metrics were investigated. The metrics include particle active surface area, black carbon (BC) mass, particle number (PN), solid particle number (SPN), and suspended PM mass (from particle size distributions and effective densities). Suspended PM mass calculated from particle size spectra and effective density profiles correlated best with respiratory system deposited particle mass, followed by mAMS measured organics, active surface area, and BC mass. Considering the accessibility and cost of these measurements, we propose the particle active surface area and BC mass to be considered when evaluating/monitoring lung deposited PM mass.

In addition with the purpose of evaluating new aerosol characterization technologies, the new inversion matrixes Soot and Compact for TSI fast mobility particle sizer (FMPS) / Engine Exhaust Particle Sizer (EEPS) and the new developed quartz crystal microbalance (QCM) cascade impactor, a real-time mass distribution measurement technology were tested to measure urban background ambient particles and compared with SMPS.