Boulder Fluid Dynamics Seminar Series

Tuesday, June 16, 2015
3:30pm-4:30pm (refreshments at 3:15pm)
Bechtel Collaboratory in the Discovery Learning Center (DLC)
University of Colorado at Boulder

Study of Flow Maldistribution in the Heat Exchanger

Hyoung-Bum Kim, *Gyeongsang National University, Korea*

An optimization study of a porous plate to improve the flow distribution in the tube side of a shell and tube heat exchanger was performed using numerical and experimental methods. The first assumption in the design stage of multichannel heat exchangers is that there is an even flow distribution along the multi channels. However, this assumption is generally not upheld in real situations. An experimental study was first performed to confirm the effectiveness of a porous baffle in improving the flow distribution in the tube side of a shell and tube heat exchanger. The results showed that the baffle can largely decrease maldistribution. We then performed numerical optimization of the porous baffle shape. The optimized curvature of a porous plate and the distribution of circular holes in the baffle were determined using the numerical method. The optimization results showed that the area-weighted averaged absolute error of the flow rate of the optimized baffle decreased to one-third that of the proto-type baffle model. For validation of the numerical optimization, the flow field with the optimized baffle was measured. Although there were some differences between the experimental and the numerical results, the results showed that the flow distribution using the optimized model was largely improved compared with that of the proto-type porous baffle.

Large Amplitude Wavelength Modulation Spectroscopy for Sensitive Measurements of Broad Absorbers

Torrey Hayden, *University of Colorado, Boulder*

This talk will present our demonstration of wavelength modulation spectroscopy (WMS) of CO_2 at pressures greater than 30 atm using a fast-scanning MEMS laser. Wavelength modulation spectroscopy is a fast, sensitive technique in which one varies the laser across an absorption feature of interest while applying a high frequency (f) modulation. The resulting harmonic signals, particularly at $2f$, are sensitive to the absorbance of light by the molecules, which is a function of gas conditions such as temperature, pressure, and concentration. Traditionally, the technique has been limited to lasers with small tuning ranges; thus the use of a MEMs VCSEL with a large tuning range enables the measurement of high-pressure gases and large molecules that were difficult to measure before. Finally, a simulation of WMS is presented that accommodates the unique properties of the MEMs laser and will enable the extraction of the gas properties from the measurements made.