

EMISSIONS

Industrial Burners

OVERVIEW

In the combustion of natural gas for heat and power generation, the emission of nitrogen oxides (NO_x) and carbon monoxide (CO) is a major concern. System efficiency, associated with higher overall thermal efficiency and therefore lower operation costs and reduced greenhouse gas emissions, is also a high priority. For safe and reliable operation, combustion stability should also be monitored. Active control, which can automatically optimize burner operating conditions, can serve the purpose of minimizing emissions, increasing/maintaining efficiency and monitoring stability simultaneously.

GOALS

- Identify burner parameters that most affect combustion performance to be used as control inputs for the feedback system.
- Develop control algorithms to attain and maintain peak performance by minimizing pollutant emissions, maximizing system efficiency and monitoring burner operation.
- Develop and evaluate real-time sensors to monitor emissions, system efficiency and reaction stability.
- Demonstrate active control on practical industrial burners.

RESULTS

An active feedback control system has been successfully developed at UCICL. It can automatically attain and then maintain optimal operating conditions. For a broad range of industrial burner types and without a priori knowledge of the relationship between burner inputs and outputs, active control minimizes NO_x and CO emissions, without sacrificing system efficiency.



Figure. 1 Burner Running Conditions

The double layer feedback control system is schematically displayed in Fig 2. The controller has the ability to respond and recover robustly to load cycling and potential hardware failures. By operating the burner at optimal fuel and air settings, the controller can attain performance values up to 25% higher than design conditions.

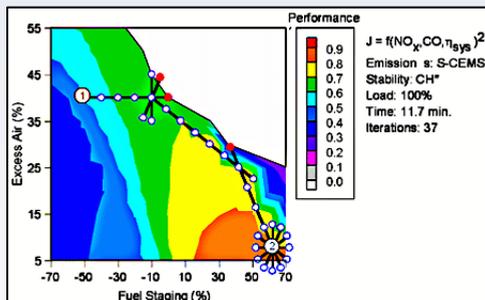


Figure. 2 Data Acquisition and Burner Control Schematic for the Active Control System

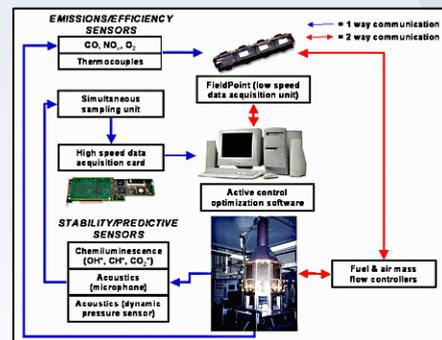


Figure. 3 Performance Maps & Optimization

The map of Fig 3 shows the optimization of a 120kW fuel-staged natural gas-fired boiler burner for a performance function J. The colored region represents stable operation conditions for a particular burner. Starting at a random point 1, the active control system will search for and locate a region of high performance 2, where low NO_x, low CO, and high system efficiency coexist.

RECENT PUBLICATIONS/PAPERS

ROBUST ACTIVE COMBUSTION CONTROL FOR THE OPTIMIZATION OF ENVIRONMENTAL PERFORMANCE AND ENERGY EFFICIENCY, Ph.D. Dissertation, University of California Irvine, 2001. (Demayo, T.N.)

PERSONNEL

Investigators: Prof. G.S.Samuelsen, Dr. V.G.McDonell

Staff: R.L.Hack, C.S.Andrews, M.D.Crespin

Graduate Students: J. Shen



UCI Combustion Laboratory

www.ucicl.uci.edu

Project Sponsors: