Monitoring Co-firing and Oxycoal Burners using Optical Sensors

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Overview

- Monitoring burners co-firing biomass
  - RFCS Project ‘Smartburn’
  - Short project overview, experiments, results & conclusions
- Monitoring oxycoal burners
  - FP7 Project ‘RELCOM’
  - Short project overview, experiments, results & conclusions

Monitoring & Control of Utility Boilers Co-Firing Biomass

- Novel Monitoring, Control and Optimisation for Utility Boilers Co-Firing Biomass
- Gas Natural Fenosa, Indra Systems, Institute of Power Engineering, University of Zaragoza & University of Glamorgan
- 2.4M€ EU Research Fund for Coal and Steel Project – July 2008 to June 2011

Research Fund for Coal & Steel

gasNatural fenosa

indra

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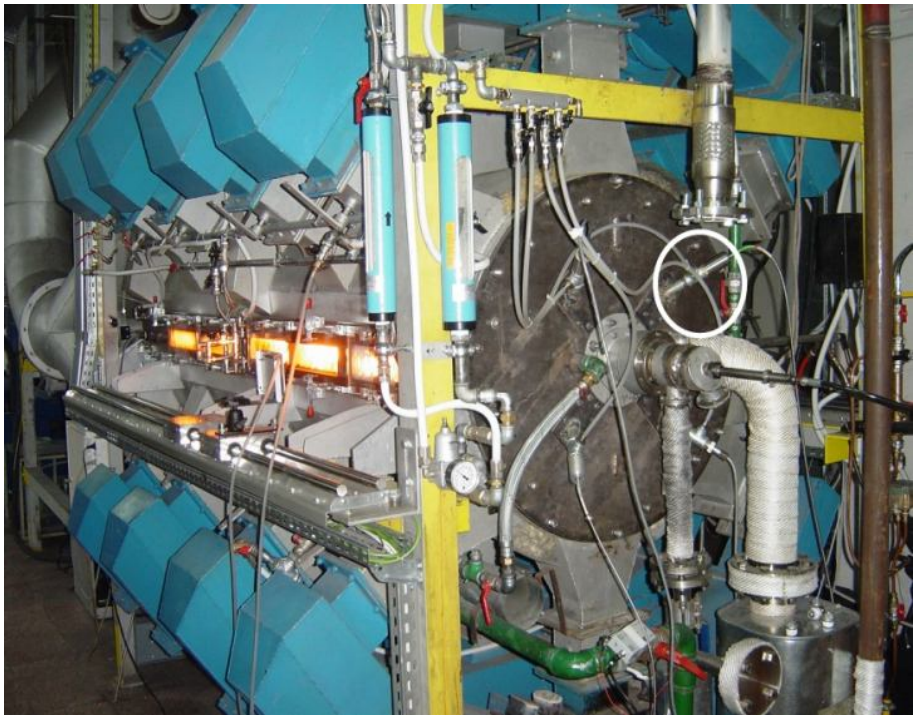
Preliminary Data Gathering Experimental Apparatus

Sensor	Responsive Wavelength	Peak sensitivity
Ultra Violet	190 to 570nm	440nm
Visible Light	320 to 1000nm	720nm
Infrared	900 to 1700nm	1550nm



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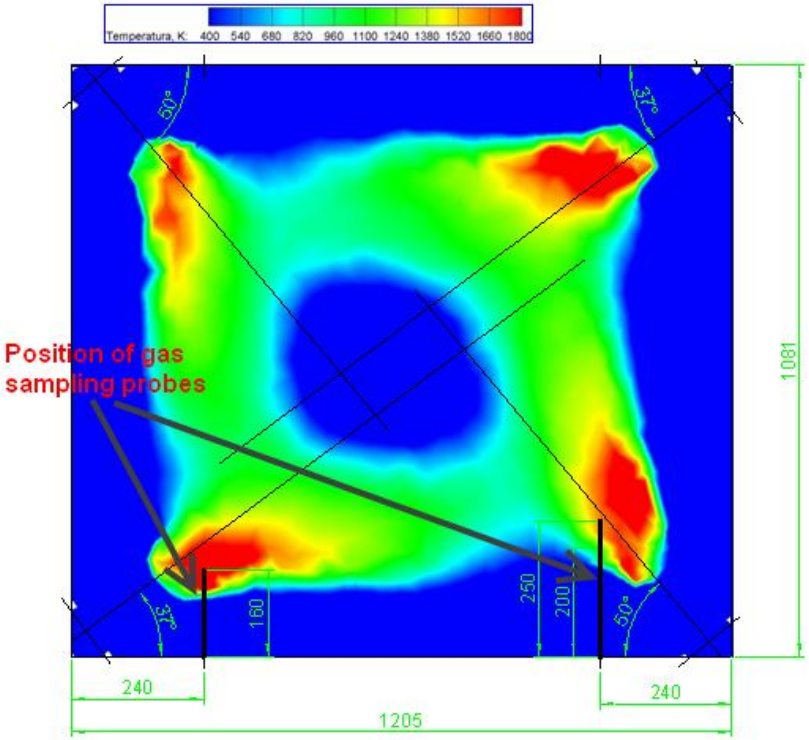
Full-Scale Burner Monitoring Locations



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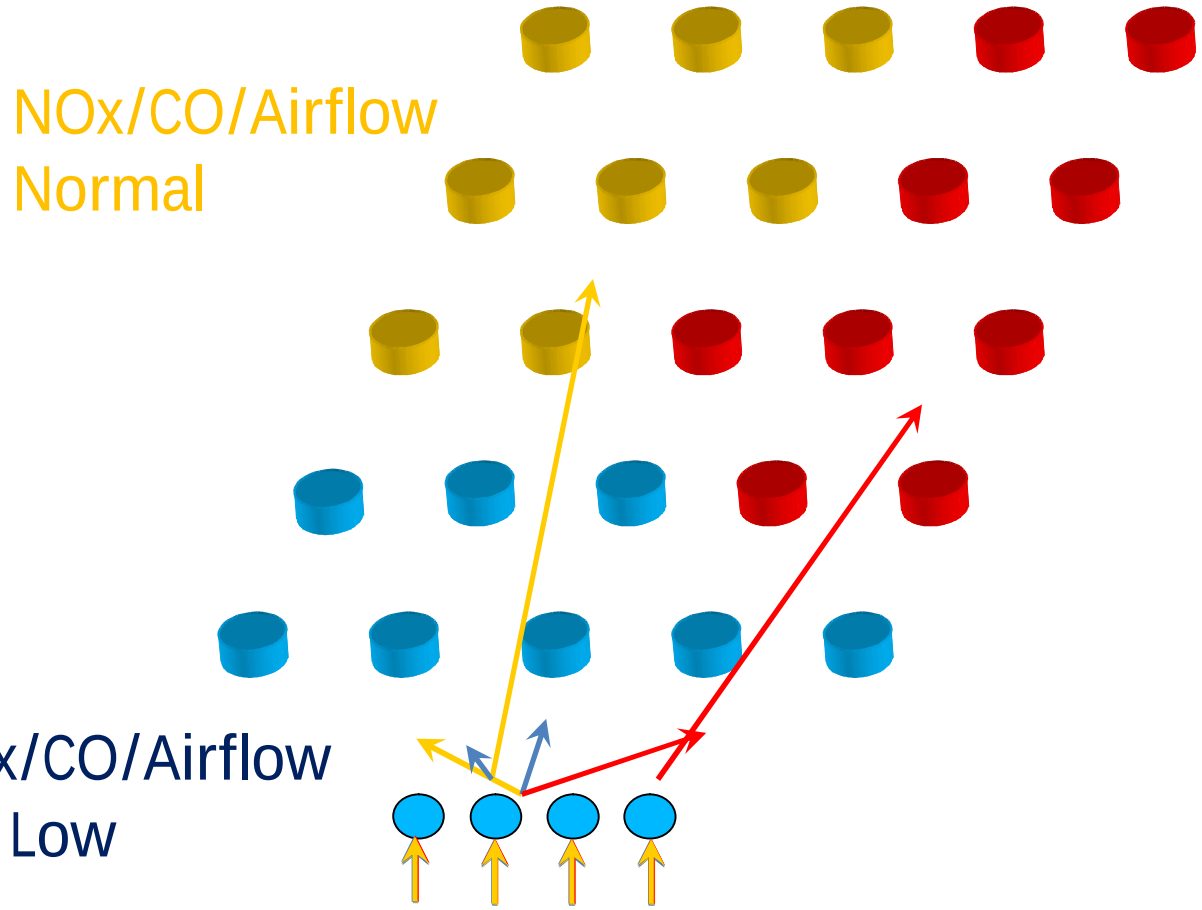
Self Organising Maps



IR, UV, Visible Photodiode
Wigner-Ville Processed Signals

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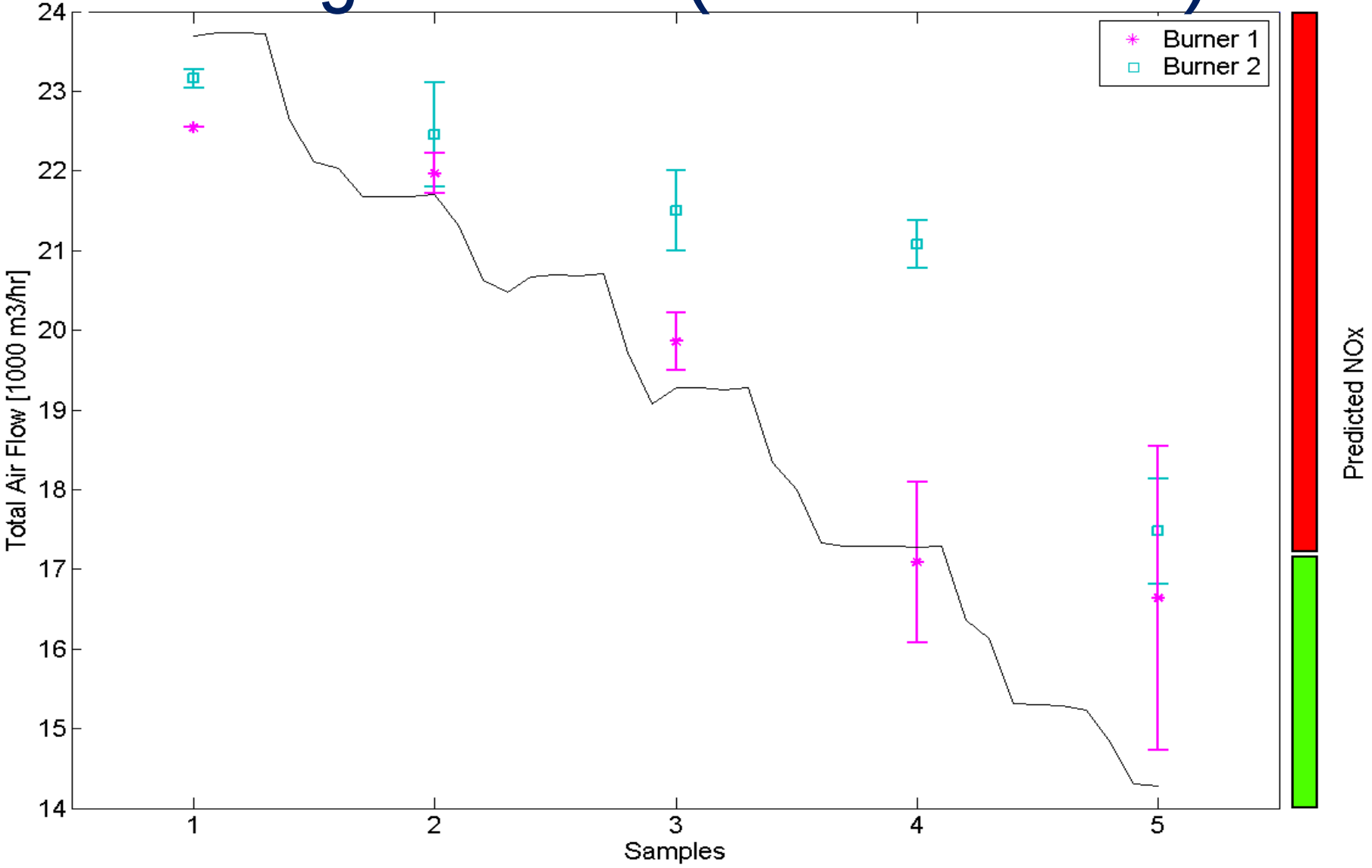
Monitoring & Controlling Two Co-Firing Burners (10% Biomass)



Summary Results

- Demonstrated burner control over wide range of conditions at 500kW
- Successfully controlled two 5MW co-firing burners on the Dolna Oldra Power Station
- Detected burner instabilities

Reliable and Efficient Combustion of Oxygen/Coal/Recycled Flue Gas Mixtures

- RELCOM is undertaking a systematic and focused series of applied research, development and demonstration activities involving both experimental studies and combustion modelling work to enable full-scale early demonstration oxyfuel plant to be designed and specified with greater confidence as well as providing improved assessment of the commercial risks and opportunities.
- 9.76M€ EU FP7 Project – December 2011 to 2015
- University of Glamorgan
  - Zone modelling
  - Burner monitoring

COOPERATION

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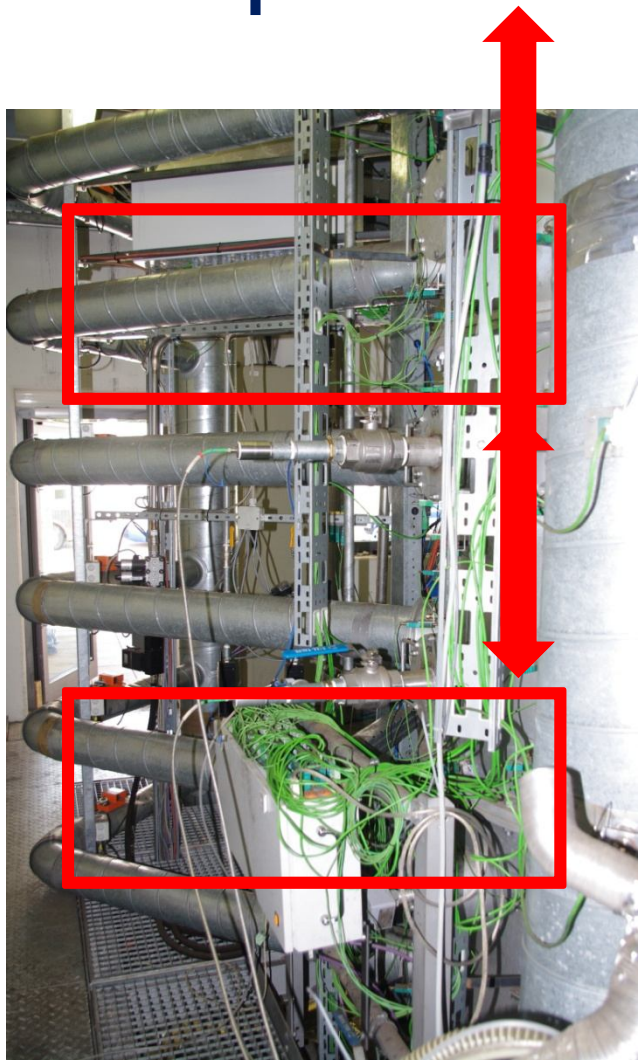
Consortium

University of Glamorgan – Coordinator (UK)	
E.On New Build & Technology Ltd. (UK)	Abo Akademi (Finland)
Electricite de France S.A. (France)	Technische Universitaet Muenchen (Germany)
Enel Ingegneria e Innovazione SpA (ITALY)	University of Leeds (UK)
Instytut Energetyki (Poland)	Katholieke Universiteit Leuven (Belgium)
International Flame Research Foundation (ITALY)	Universitaet Stuttgart (Germany)
Fundación Ciudad de la Energía (SPAIN)	Doosan Power Systems Ltd. (UK)
Third Party: Adinex (Belgium)	Third Party: E.On New Build & Technology GmbH (Germany)

Sensor placement



Burner 1

Burner Separation

500mm

Burner 2

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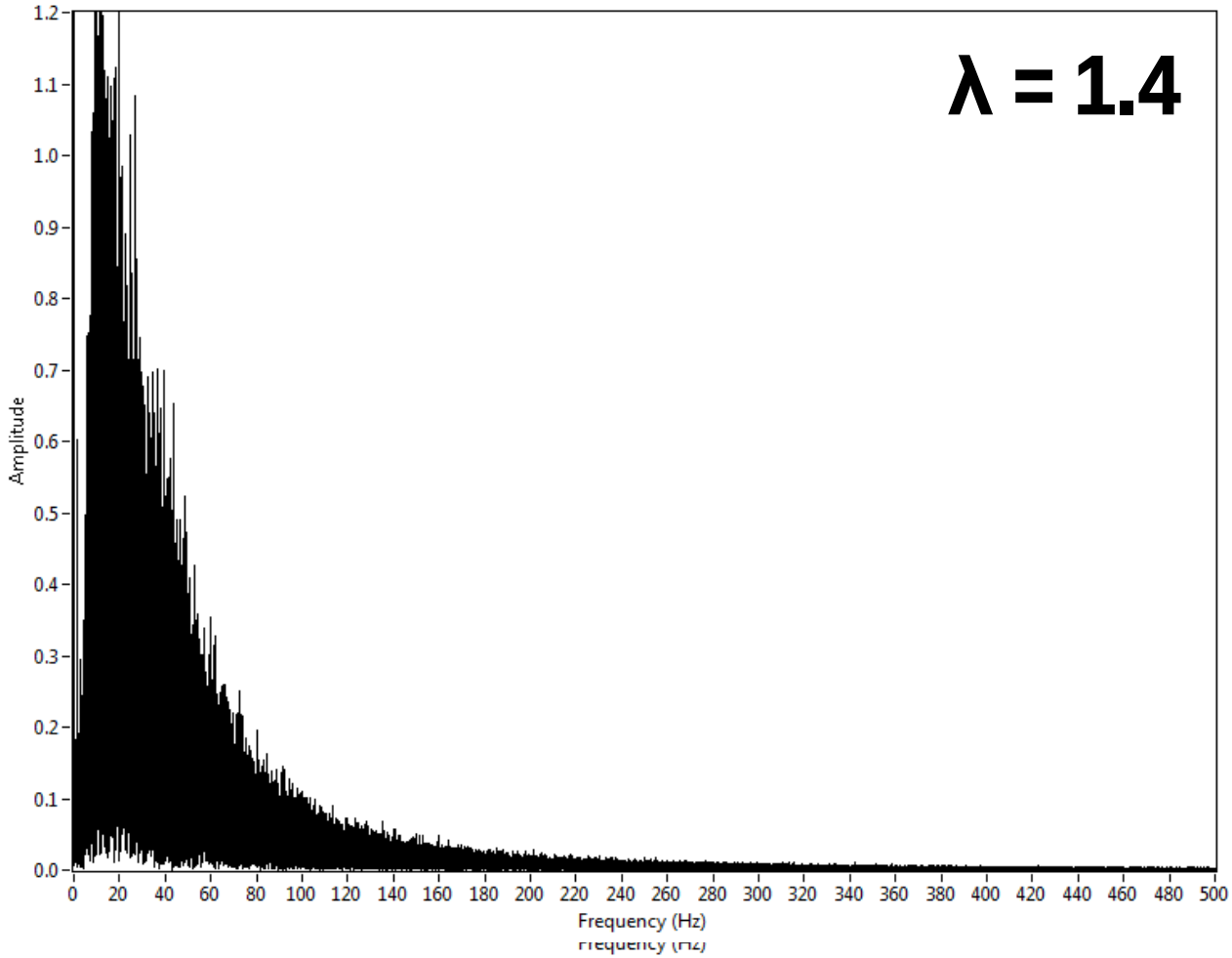
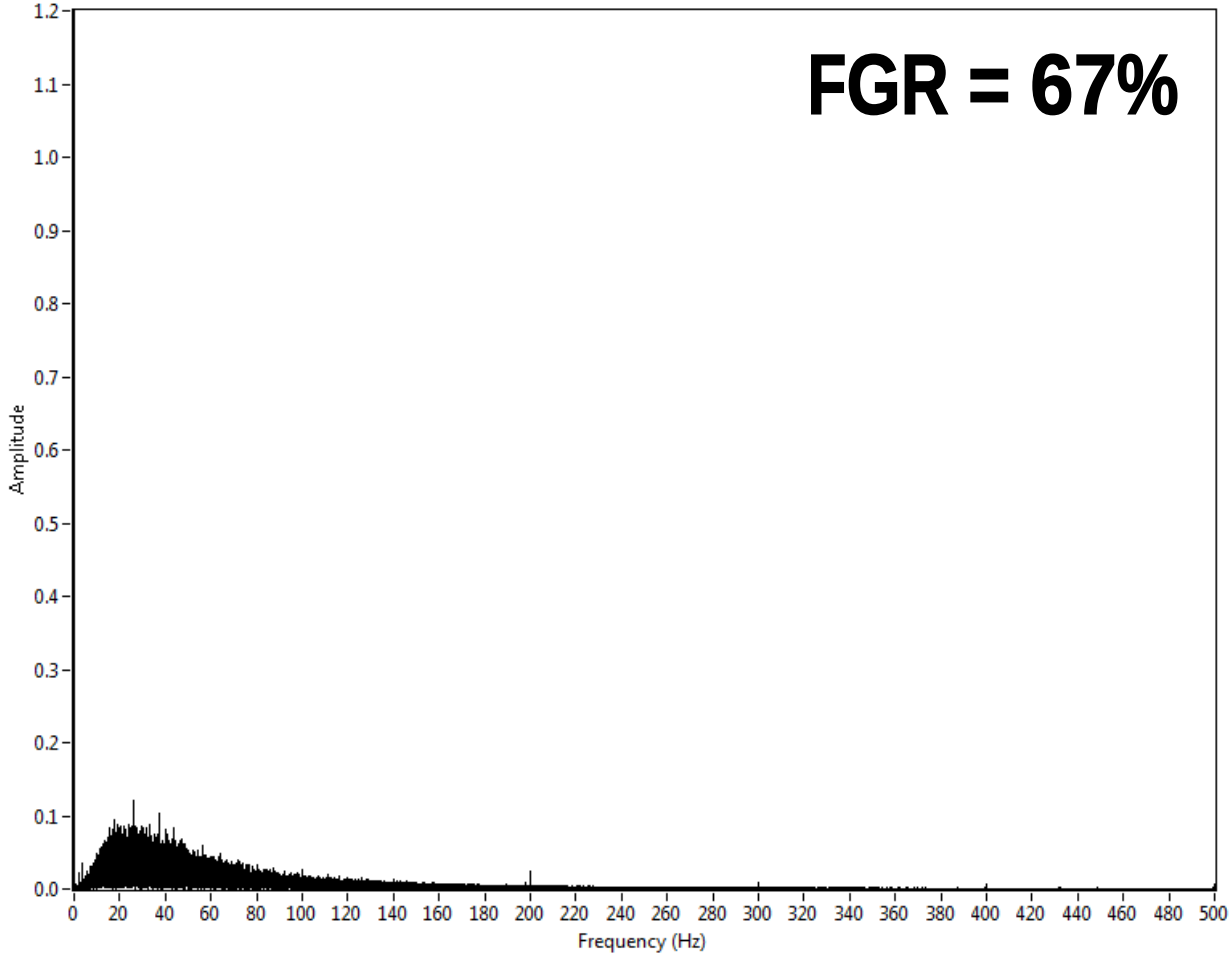
Burner Interaction Experiments

- Burner separation distance [50cm, 100cm]
- Air mode experiments for reference
  - λ – 1.05, 1.15, 1.4
- Oxycoal mode experiments
  - λ – 1.05, 1.15, 1.4
  - Flue gas recirculation rates; 50%, 60% & 67%

Visible Flame Emissions
Burner Separation 50cm, Recycle Rate 50%



UV Flame Emissions
Burner Separation 100cm, λ = 1.15



Summary Results

- Trends observed for all sensors, and for both burner separation distances
  - Increase in λ – increase in signal strength
  - Increase in the Flue Gas Recirculation rate –decrease in signal strength
- No detectable burner interaction traits seen

Final Summary

- Use of low cost photodiodes, through suitable signal processing, enables;
  - Monitoring of flame condition
    - Coal, Coal/Biomass, Oxy, Gas
  - Control of some characteristics
    - NOx & CO
  - Detection of burner instabilities
  - Could be integrated into boiler control system