



# D I A L

**Diagnostic Instrumentation & Analysis Laboratory**  
 Mississippi State, MS 39762-5932

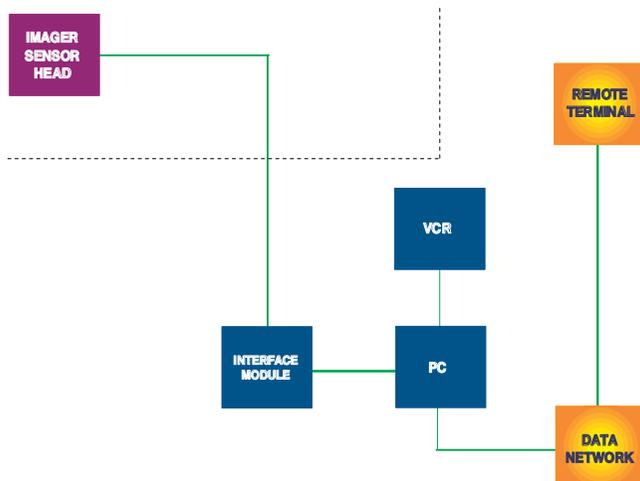
## Imaging Technologies

### Applications

Researchers at DIAL have recently developed imaging systems for the determination of surface temperatures and emissivities and for qualitative evaluation of gas stream constituents. Typical applications of these systems have included furnace refractory and tube measurements, melt, slag, and pour temperatures, and as alarms for process components. The instruments provide detailed spatial, thermal, and temporal evaluations while supporting operator decision-making. This technology is directly useful in manufacturing, surveillance, and QA/QC.

### Instrumentation

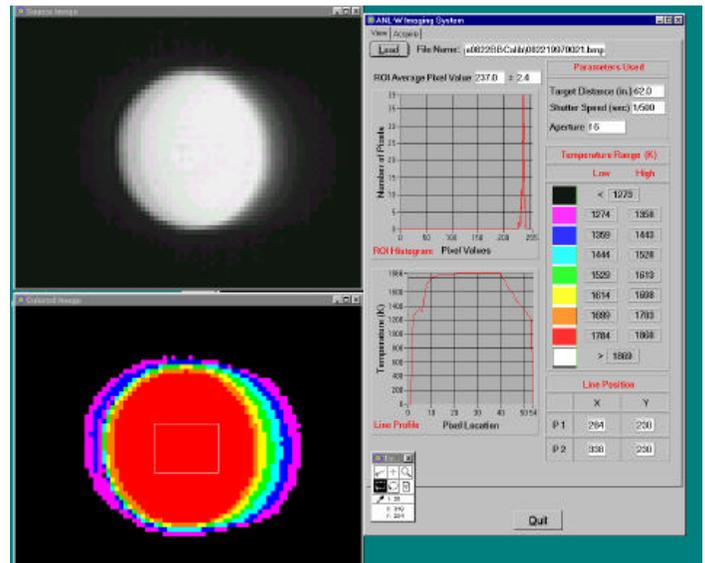
The basic configuration (Figure 1) includes an imager, an interface module, a computer, and a video cassette recorder. The interface module, PC, and VCR can be located up to 100 feet from the sensor, thereby providing for remote operation and/or measurements within restricted areas.



*Fig. 1. Basic configuration of the imaging system.*

The detector assembly consists of optics, the CCD array and electronics, and a positioning unit. Movement of the camera is possible using a joystick mounted on the front panel of the interface unit. Selection of imager parameters such as shutter speed and remote iris and focus is by user input to the system software.

The main software screen consists of the original gray scale image, the on-line processed image, and the control panel (Figure 2). The software



*Fig. 2. System screen layout.*

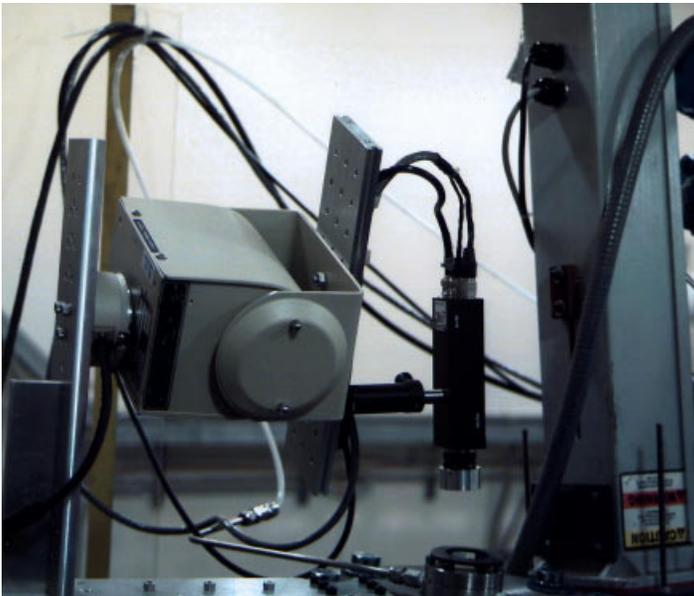
provides for acquisition, image operations, storage, and post processing. Toolbox features include line profile, area of interest, single pixel evaluation, and magnification. Transfer of results to a network is supported. Other user selectable options include: shutter speeds from 1/60 - 1/10,000 sec and image storage rates as fast as 1 Hz. The spatial resolutions of the system at a target distance of 1.58 m using a 25 mm objec-

tive are 0.81 mm/pixel (h) and 0.82 mm/pixel (v), and these values correspond to an imaged area of 52 x 39 cm.

The image shown was obtained during system calibration and illustrates pixel uniformity. The color coded image is based on similar data collected at different temperatures. A temperature range from 800 - 1600°C (1472 - 2912 F) was obtained. The temperature resolution was found to be < 5°C/pixel unit (8 bit, 0 - 255). Different temperature ranges and spatial resolutions can be obtained through different optical configurations.

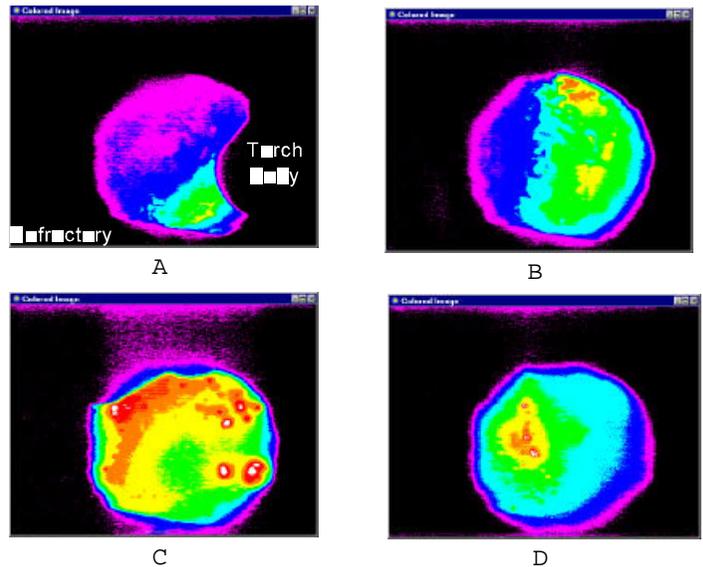
### Furnace/Melter Measurements

Installation of the sensor on a plasma torch furnace and corresponding images obtained during operation are given in Figures 3 and 4. The cen-



*Fig. 3. Imager located on plasma furnace.*

tral portion of the images corresponds to the melt, while the outer edges to the bottom and left correspond to the refractory of the crucible. Images 'A' and 'B' were acquired 7 and 8 minutes



*Fig. 4 Images from plasma torch operation.*

after the torch was started. In 'A' the torch body is visible and in 'B' the torch had recently moved over the hotter (red) area to a different melt location. The third image 'C' was collected during surrogate waste processing and image 'D' was taken one minute after the torch was shut off. The images illustrate the rapid changes in temperature that can occur in this furnace and provide information on heat transfer and efficacy of melting/ waste processing.

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### Availability

The imaging systems are available as customized units. Additional activities include field measurements and evaluations of advanced technologies. For further information please contact J. S. Lindner at:

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