

# Shipbuilding Welding Video Project

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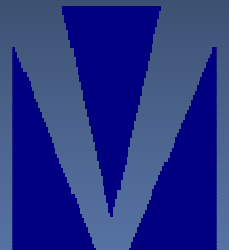
2011 @ VisibleWelding . com  
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VISIBLE WELDING



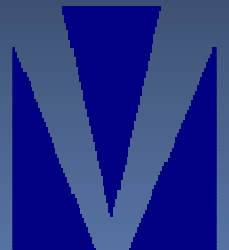
# Video Usage

- Monitor automated weld machines
- Operator adjustment of semi-automatic welding
- Welding education
- Develop new weld procedures
- Archival record of welds

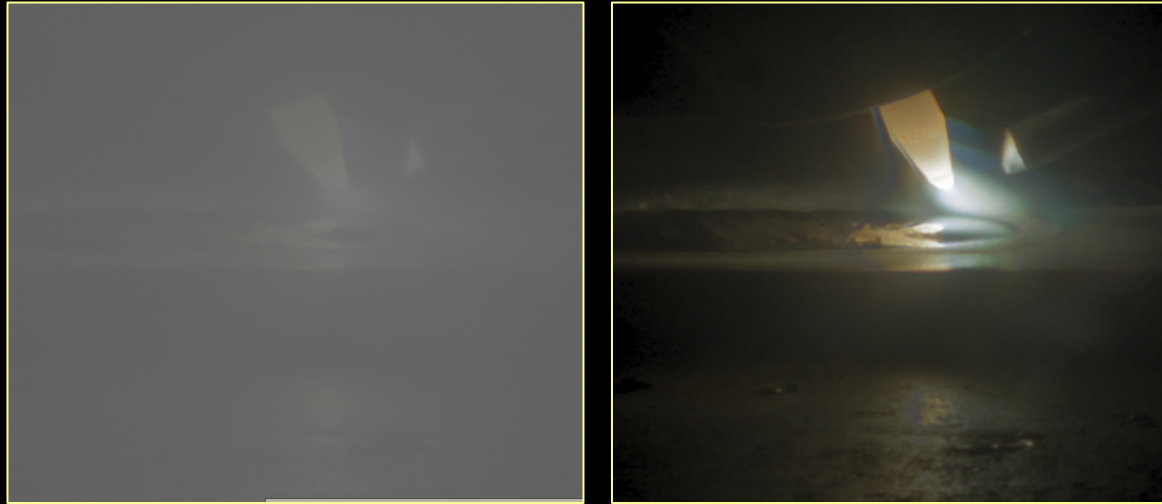


# Capture challenges

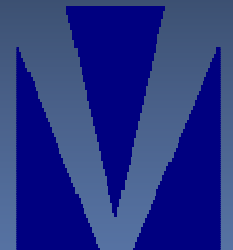
- Arc scene has very high dynamic range
  - Arc light is ultra-bright
  - Arc light can be time-varying
- Weld metal is dark and poorly illuminated
  - External lighting is relatively dim
  - Arc area shielded for safety
  - Arc light co-planar with metal



# Display challenge

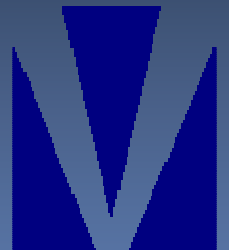


- Displays have limited light range – even less than a “normal” camera
- Need to use human visual system
  - Techniques from Renaissance painting to modern psycho-graphics science.



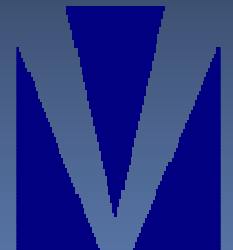
# Proposed study to focus on Capture (not display)

- **Primary:** For shipbuilding
- **Secondary:** Educating welders



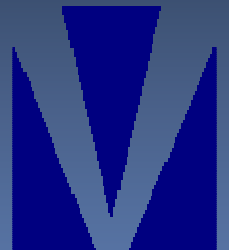
# About Visible Welding

- Consulting Business since 1991
  - Digital video systems: Security, PC, Broadcast
- Clients include
  - Cisco
  - IBM
  - Kodak
  - Lockheed
  - Sony
  - QinetiQ
  - Analog Devices
  - Broadcom
  - DynaPel
  - IC Works
  - Macronix
  - S3



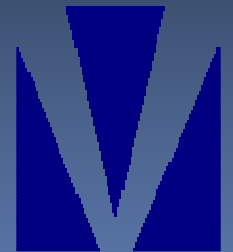
# About Visible Welding

- IP Licensed to:
  - Analog Devices
  - Cypress Semiconductor
  - For-A (Tokyo)
  - Lockheed-Martin
  - Tektronix



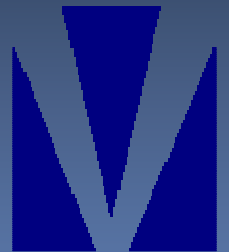
# Welding Camera Roots

- Grew out of consulting in 2007
- Solve with digital imaging technology
- Welding industry volume too small to interest camera companies
  - Industrial market of 100k units
  - Educational market 10k units
  - Specialty much smaller (e.g. Shipbuilding)



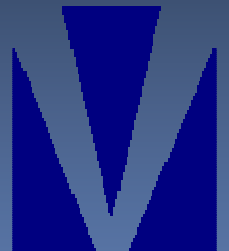
# Where Angels Fear to Tread

- Bootstrap Commercial Startup
  - Founded by Steven Edelson
- Video hardware and software strength
  - EE (MIT)
- Welding novices



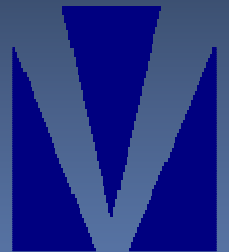
# Contributor Credits

- **Camera Digital Electronics**
  - Dr. Michael Aronson, CEO, Rumble Dev.
- **Optics**
  - Leon Levinson – Retired Chief Scientist, Technicolor
- **Video Algorithms**
  - Dr. Klaus Diepold – Professor Technical Univ. Munich
- **Lens Electronics**
  - Dr. George Heron – Former VP Eng, Kodak
- **Camera System**
  - Dr. Ellen Cargill – Former designer, Polaroid

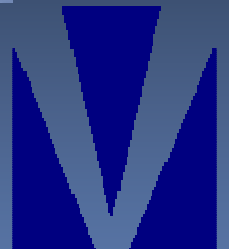


# First Generation Welding Camera

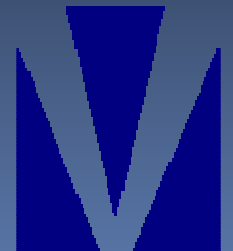
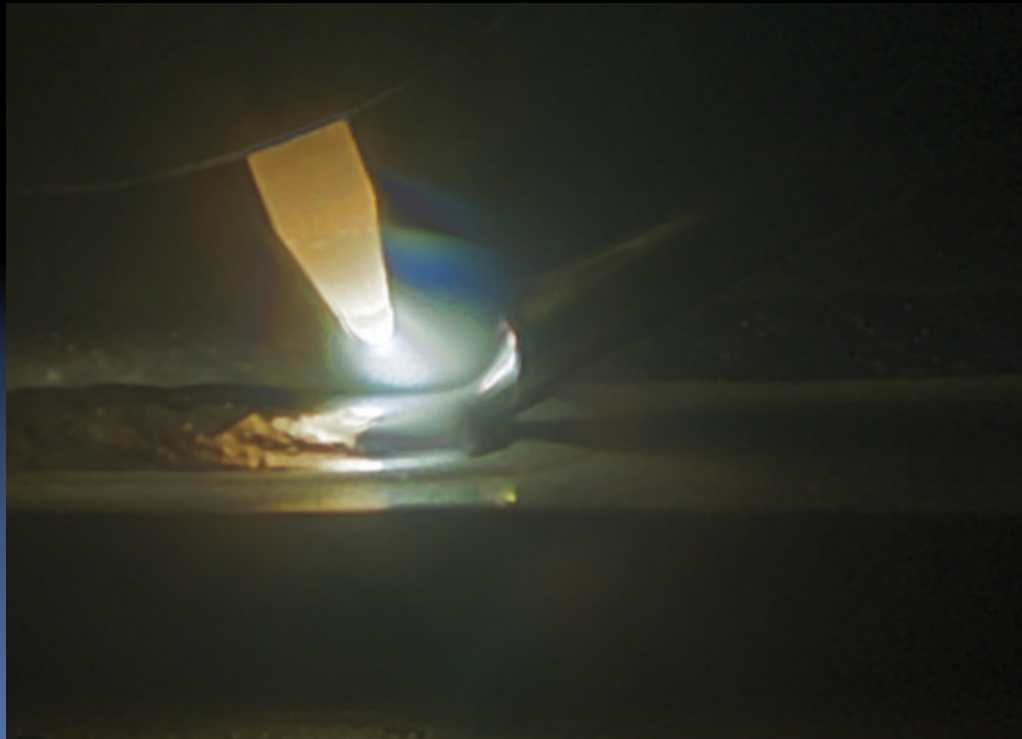
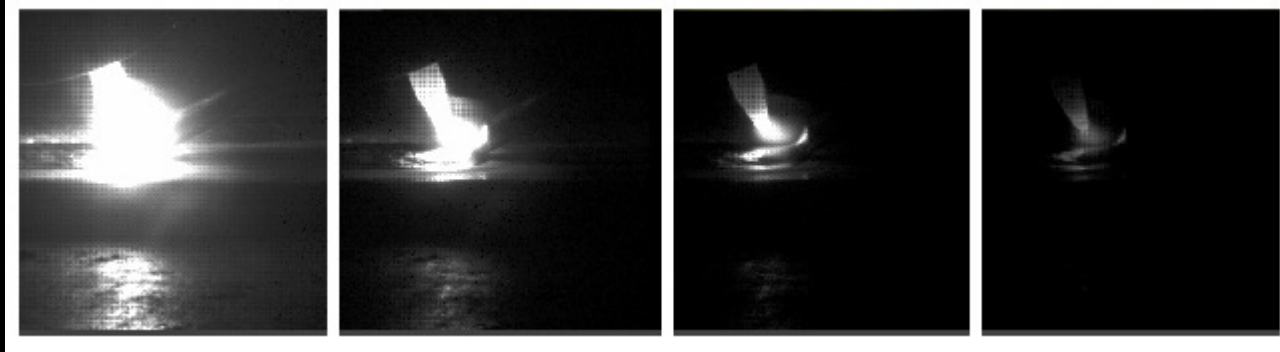
- Marriage of modern digital camera and computer image processing
- Meet industrial needs (largest volume)
- Avoid special filters and analog tricks
  - Ride advances of digital imaging industry
  - Ride advances of semiconductor power



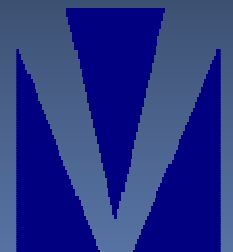
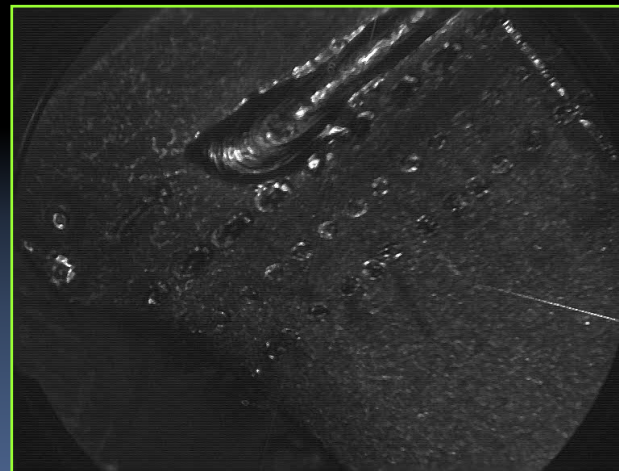
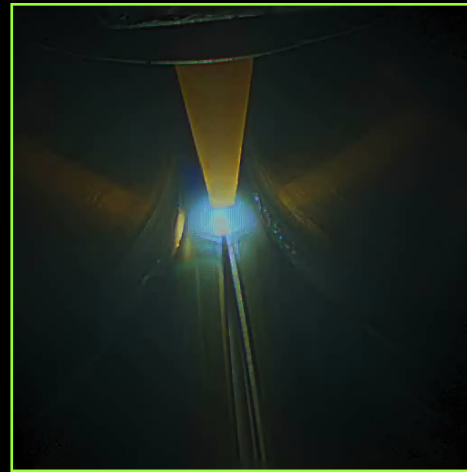
# Imaging Head plus Fast CPU



# Multiple Images Fused into One

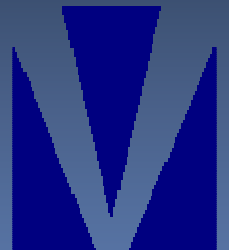


# Demo Videos



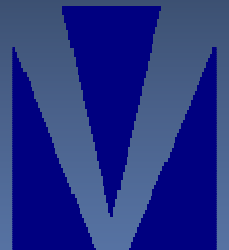
# Road forward

- Ruggedized version for industry
  - Collaborating with US distributor, Intertest
- Version for education
  - Miller Electric input
- Specialty version for niches (shipbuilding)



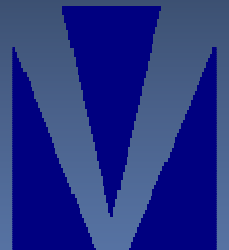
# Shipbuilding Weld Video

- Exposure to shipbuilding revealed differences from industry welds
  - Metal and process parameters different from industry
  - Light more intense
  - Larger range from weld to setup
- New technologies are now available
- Repeat process of industrial design



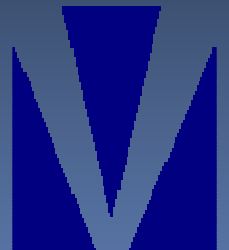
# Project Goals

- Select among new sensor technology for shipbuilding welds
- Identify advantageous non-standard camera hardware
  - Electronic or optical
  - Prototype and test if feasible
- Identify and test advantageous algorithms



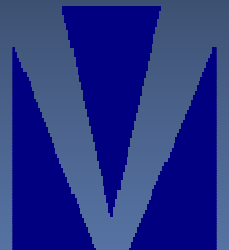
# Sensors advancing for High-dynamic-range imaging

- Multiple-slope exposures
- Multiple exposures fused into one
- Logarithmic sensors



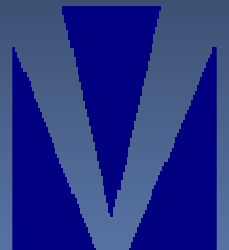
# HD sensor suppliers:

- Cypress-Ibis (France)
- Micron-Aptina (USA)
- Pixim-Orca (USA)
- E2V EV76C560 (UK)
- NIT (France)
- IMS (Germany)



# Project outline

- Survey and prioritize shipbuilding welds
- Preliminary light measurements
- Select sensor tech. most likely for priority welds
- Acquire or build cameras with selected sensors
  - Perform custom mods for arc requirements
- Generate test software
- Record performance on live welds
- Report (text and video)



Thank you.

# VISIBLE WELDING

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