BLAST FURNACE CFD SIMULATION AND VR VISUALIZATION

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“Where Ideas Become Reality”
CIVS ROAD TO HPC APPLICATIONS

- CFD Applied to Refinery, Glass…
- CIVS Sim. & Vis.
- HPC4Mfg BF Seed Grant
- HPC4Mfg BF Phase II

- Blast Furnace (BF) CFD Modeling
- NIST AMTech Grant
- Steel Manufacturing Simulation and Visualization Consortium (SMSVC)
CIVS (Since 2009)

➢ Mission
  • Innovation
  • Application ($40+ million savings)
  • Education (1000+ students)

➢ Strategies
  • Integration of technologies
  • Application driven approach
  • Partnerships (110 partners)

➢ Applications
  • Optimization & troubleshooting
  • Design & scale-up
  • Training

“A picture is worth a thousand words.” - F. Barnard, 1921
“An interactive simulation is worth a thousand pictures and million $$$. ”
STEEL MANUFACTURING SIMULATION AND VISUALIZATION CONSORTIUM (SMSVC)

**Mission:** To develop and implement innovative technical solutions through advanced simulation and visualization technologies to ensure a competitive advantage for US steel manufacturing.

1) Workplace Safety
2) Energy Efficiency
3) Operation Efficiency
4) Reliability and Maintenance
5) Workforce Development
6) Environment Impacts
7) Raw Materials Utilization
8) Smart Manufacturing
CFD SIMULATION AND VISUALIZATION OF BLAST FURNACES (2002 - 2015)

Issues:
• Campaign life
• Energy efficiency
• Downtime
• Training

Outcome:
• Virtual blast furnaces
• Copyrighted software
• Multimillion $$$ savings
• Significant downtime reductions
• Six Best Paper awards

Collaborators: ArcelorMittal USA, ArcelorMittal Dofasco, AK Steel, Stelco, Union Gas, and U.S. Steel
Supporters: DOE AMO, AISI, AIST, and Companies
HPC4Mfg SEED GRANT & PHASE II

- LLNL Technical Manager: Dr. Aaron Fisher
- Goals:
  - Significantly reduce computational time
  - Improve model resolutions
  - Integrate blast furnace models for process control, optimization, design and troubleshooting
  - Use for smart manufacturing

- Parallelization
- CS expertise
- HPC
- Model Development
- Simulation
- Visualization
- Industrial know how
- Implementation
SAMPLE RESULTS & EXPECTED OUTCOMES

Phase I:
- Run 126 cases with various operating conditions
  - 64 HPC cores: 48 hrs (2 days)
  - 8 PC cores: 756 hrs (31 days)

Expected results in Phase II:
- 100 times faster
- Help reduce coke consumption by 5%, potentially saving $80M/yr
EXAMPLE OF TROUBLESHOOTING
U.S. Steel GW #14

➢ Issue:
  ▪ Downtime due to lance failures

➢ Outcomes:
  ▪ Cause of failures
  ▪ Design modification
  ▪ No more lance failures
Thank You!

http://centers.pnw.edu/civs/
www.steelconsortium.org