Self-healing Mixing Boxes: A Step Beyond Fault Detection and Diagnostics

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What is self-healing?
- Systems and/or controls that automatically implement solutions to faults in their operation

Why self-healing?
- Automated fault detection and diagnostics provides information that is useful theoretically, but a commitment for human action is required to capture benefits
- Self-healing systems/controls correct faults automatically
  - Faults corrected by changes in parameters and software code
  - Faults mitigated by automatically reconfiguring or redesigning controls
  - Can correct some physical failures for which physical or analytic redundancy exists (e.g., virtual sensors)
  - Cannot correct for many physical failures – compressor failure
Self-Healing Process

System Operating Fault or No Fault?

Passive Observational Fault Detection

Fault Detected

Specific Fault and Location Identified

Proactive Testing to Isolate Faults (Diagnosis)

Fault Mathematically Described

Proactive Testing and Analysis to Characterize Faults

Mathematical Fault Correction

Fault Corrected
Self-Healing Process Implementation

Actuator Signal

System

Virtual Sensor

Controller

Changes to Control Constants

Function for sensor correction

Fault Detection, Fault Isolation, Fault Characterization, and Fault Correction Processes

Signals from other sensors on this system or other connected systems

Signals to implement proactive tests

Raw Sensor Signal x

x_v(x)
Mixing-Box Faults

- Biased or Drifting Air-Temperature Sensors
- Incorrect Minimum Outdoor-Air Damper Position
- Supply-air Flow-rate Sensor Bias
Return-air Temperature Sensor Bias of -5°F
Incorrect Minimum Outdoor-Air Intake Damper Position

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Supply-Air Flow-Rate Sensor Bias of +50 ft³/minute (cfm)
Mixing-Box Application – System Components
Mixing-Box Application – Point Mapping
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Thank you!

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