Falcon: Visual Analysis of Large, Irregularly Sampled, and Multivariate Time Series Data in Additive Manufacturing

Achievement: Developed a new visual analytics system (“Falcon”) to interactively explore large, time-oriented data sets from multiple linked perspectives.

Significance and Impact: Understanding and extracting information from lengthy and irregularly sampled time series presents a significant challenge in additive manufacturing as well as other domains. This work developed a new scalable tool, that provides researchers with visual overviews, the ability to explore trends, link observed behaviors and understand trends. In a case study with additive manufacturing experts, the use of Falcon resulted in new discoveries about the process at hand.

Research details:
- Developed a visual information seeking tool named Falcon for non-visualization experts that supports exploratory time-series analysis
- Designed new human interaction techniques for visualizations (e.g., waterfall visualization)
- Integrated time series similarity matching algorithms to guide users to important patterns, based on the user’s interaction
- Case study to demonstrate tool effectiveness

Sponsor/Facility: Work was performed at ORNL. It was sponsored by DOE/AMO.

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Overview:
Flexible visual analysis of long, high-resolution, and irregularly sampled time series data from multiple sensor streams is a challenge in several domains. In the field of additive manufacturing, this capability is critical for realizing the full potential of large-scale 3D printers. This work proposes a visual analytics approach that helps additive manufacturing researchers acquire a deep understanding of patterns in log and imagery data collected by 3D printers. Specific goals include discovering patterns related to defects and system performance issues, optimizing build configurations to avoid defects, and increasing production efficiency. We introduce Falcon, a new visual analytics system that allows users to interactively explore large, time-oriented data sets from multiple linked perspectives. Falcon provides overviews, detailed views, and unique segmented time series visualizations, all with adjustable scale options. To illustrate the effectiveness of Falcon at providing thorough and efficient knowledge discovery, we present a practical case study involving experts in additive manufacturing and data from a large-scale 3D printer. Although the focus of this paper is on additive manufacturing, the techniques described are applicable to the analysis of any quantitative time series.