



Measuring Insight Into Multi-dimensional Data from a Combination of a Scatterplot Matrix and a HyperSlice Visualization

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The Internet of Things and Production



Pervasive digitalization

Integrated cyber-physical systems

- Improved capacity utilization
- Improved cost-effectiveness

Foster innovation

Challenges in Industrie 4.0

What will we have to adapt to?

Transition in engineering work

- Self-optimizing, individualized, integrated processes
- Regulatory and monitoring tasks

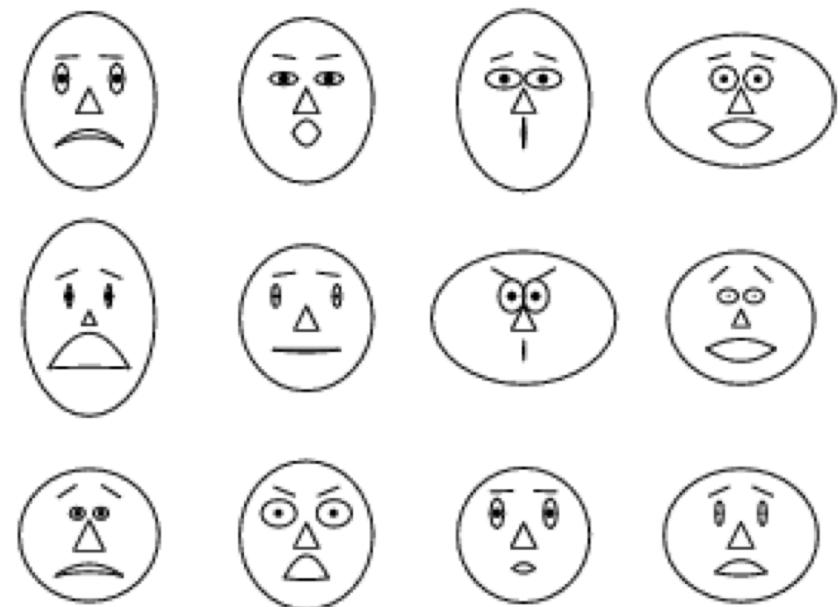
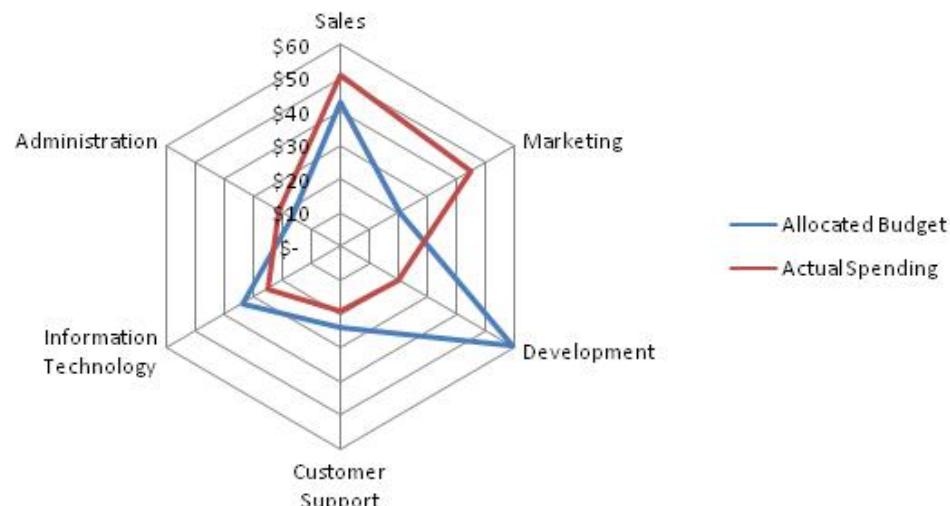
Challenges in

- Managing knowledge
- Sharing responsibility
- Dealing with **complexity**

Complexity

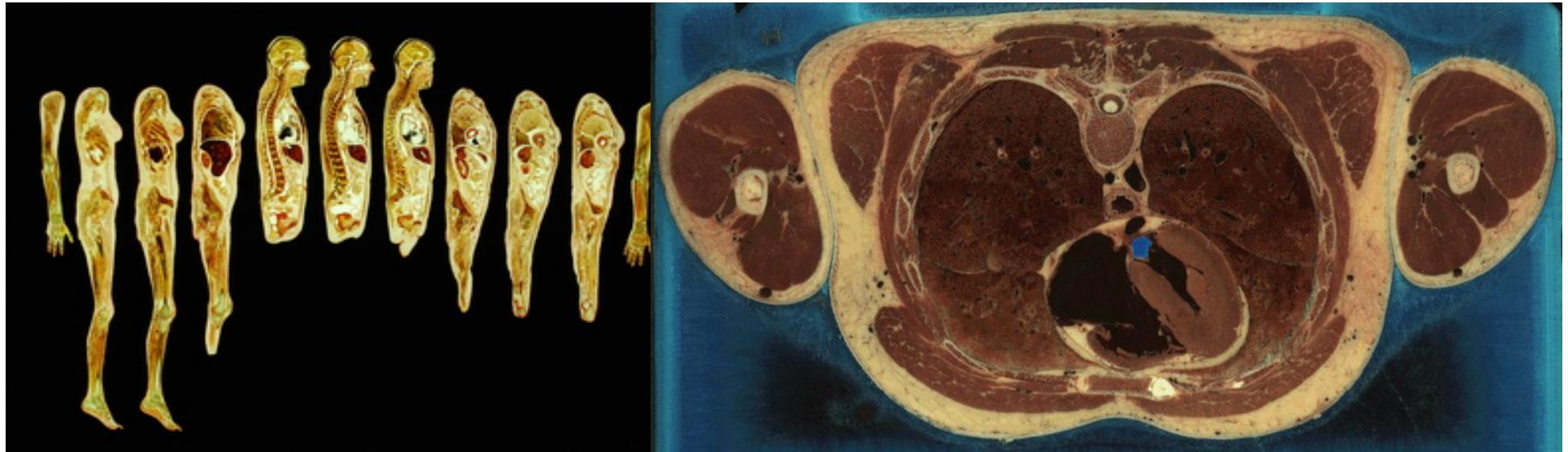
Multi-Dimensional Data

- How can users understand and manage multi-dimensional data?
- One Approach: Visualization
 - Hyperslicing, Star-coordinates, Chernoff-Faces, etc.



How to present multi-dimensional data?

- Slicing of Spaces
 - Volumetric view of 3D-Space
 - Move the „cutting plane“ in one dimension



But what about higher dimensions?

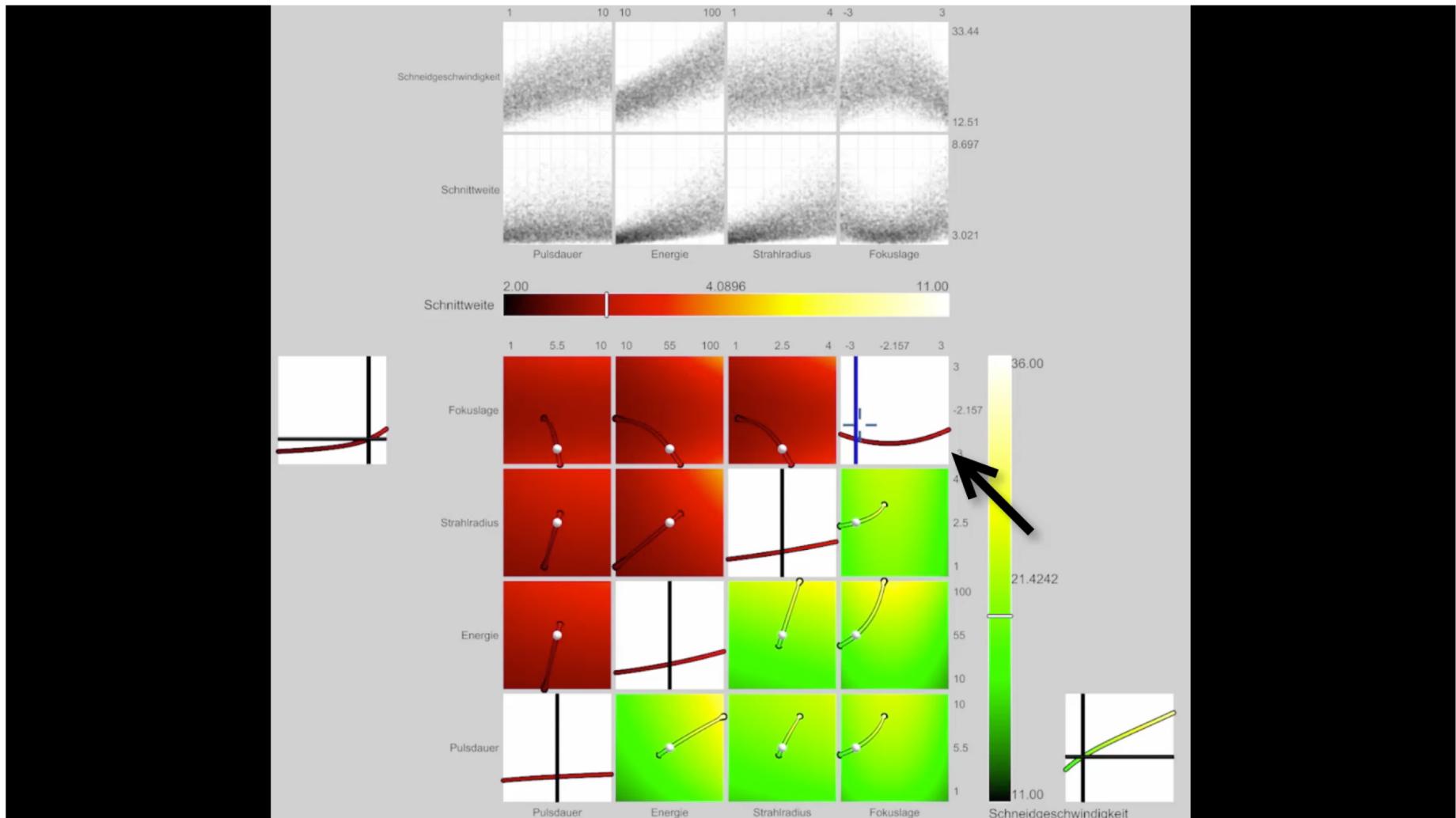
... and also abstract parameter data?

One Example Application

Multi-dimensional Dependencies

- Hyperslice Visualization
- 2 Visualizations
 - Scatterplot Matrix
 - Hyperslice Matrix
- Hyperslice
 - Each slice presents a 2D-plane from a 6-Dimensional Hyperspace
 - Each Slice presents 3 dimensions
 - X/Y + Color

Hyper-Slice in Action



User Study

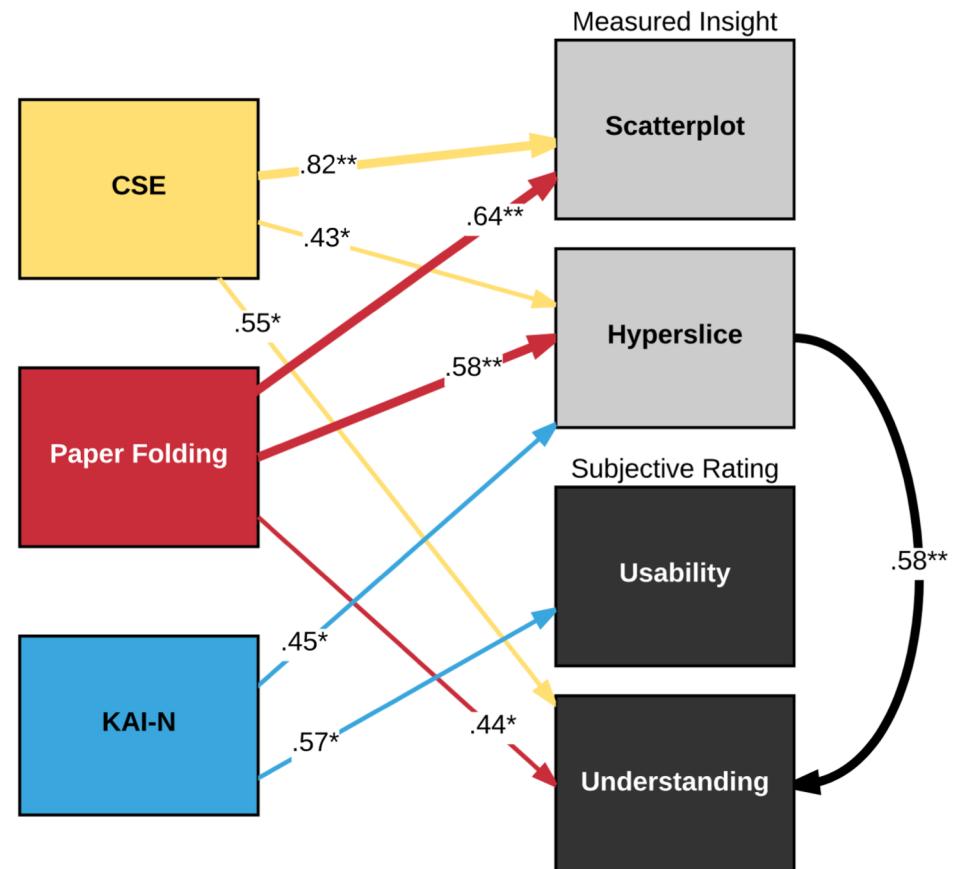
Measuring Insights with 16 engineering students

- We assessed fluid and crystal intelligence (KAI-N)
- Mental rotation capability (Paper Folding Test)
- Computer self-Efficacy (KUT)
- 30 minute tutorial in using the software
- 60 minutes tests
- Measured insights (novel realizations from software and data)
- Usability and Understanding
- **Data contained a 3-Dimensional dependency!**

Results

Insights correlate with cognitive abilities

- Strong influence of mental rotation capabilities
- Computer self-efficacy influences Scatterplot insights
- Not everyone can derive multi-dimensional insights from our visualization.
- **Everyone was able to perform optimization task!**



Summary

Thank you very much for your attention!

- We investigated insights from high-dimensional data
- Controlled for cognitive abilities
- Mental rotation skill is important for generating insights
- Optimization task with steepest descent can be performed without insight
- **Decision Support!!**

