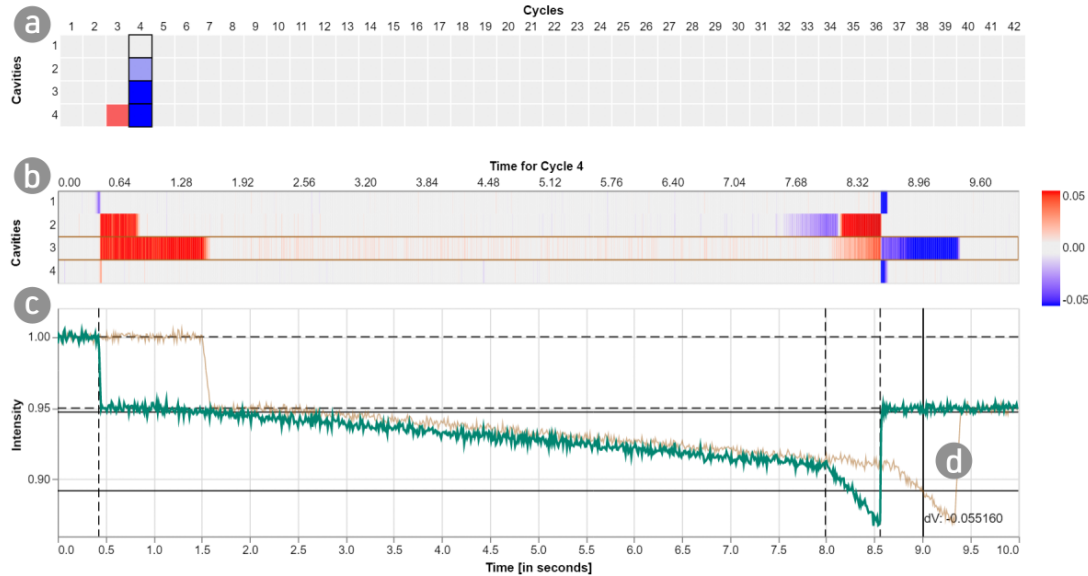


# Visualizing and Monitoring the Process of Injection Molding



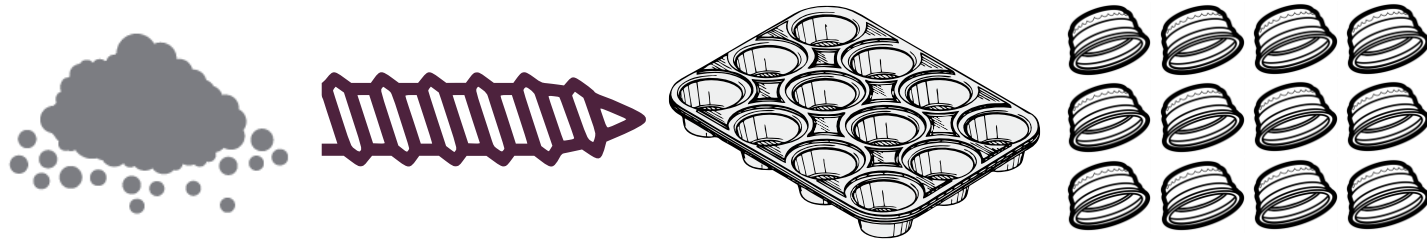
Christian A. Steinparz, Thomas Mitterlehner, Bernhard Praher, Klaus Straka, Holger Stitz, Marc Streit



# Injection Molding



# Injection Molding



# Injection Molding

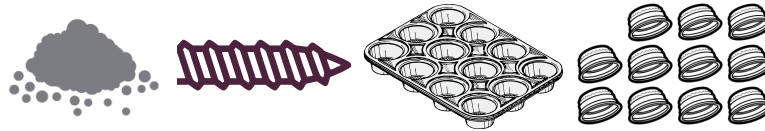
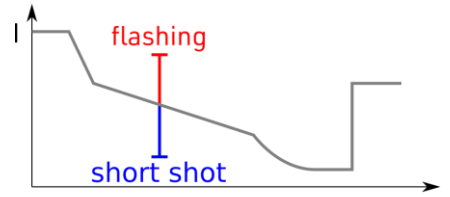


# Injection Molding

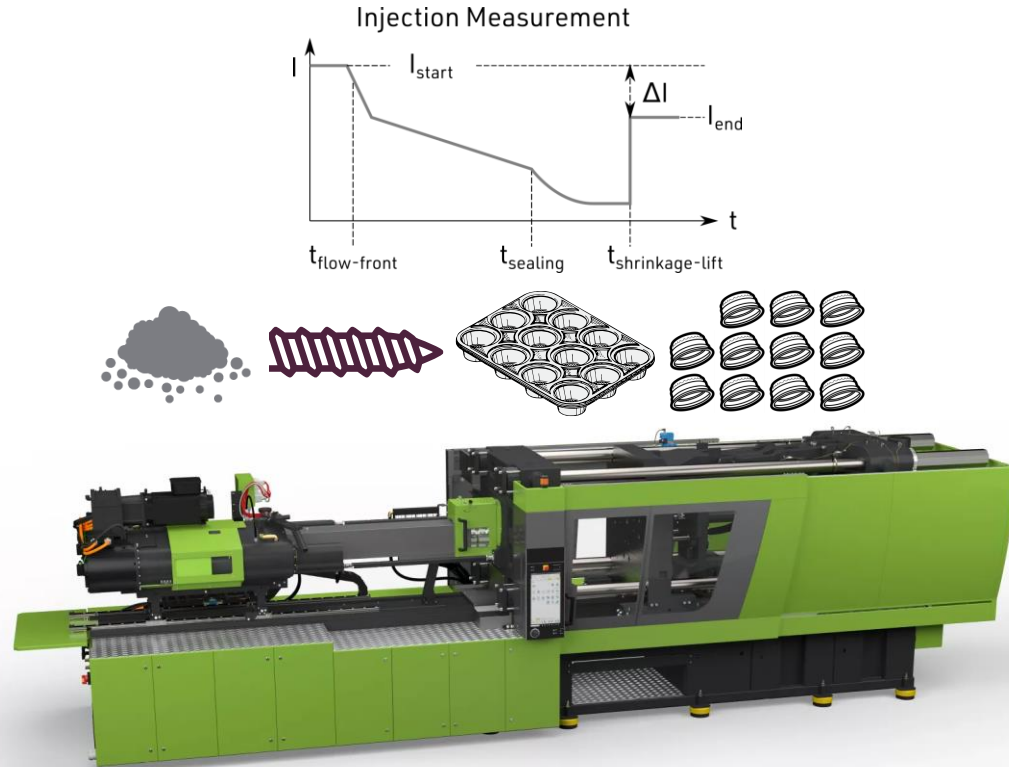


# Injection Molding

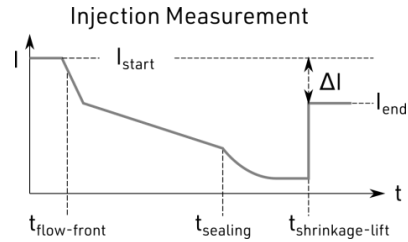
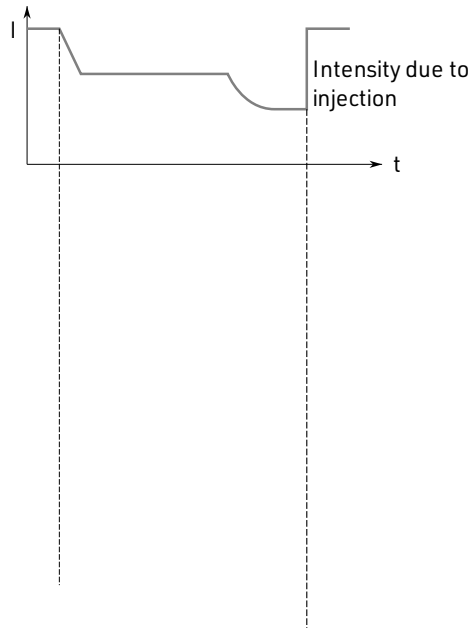
Injection Measurement



# Injection Molding

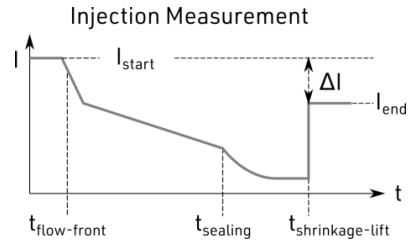
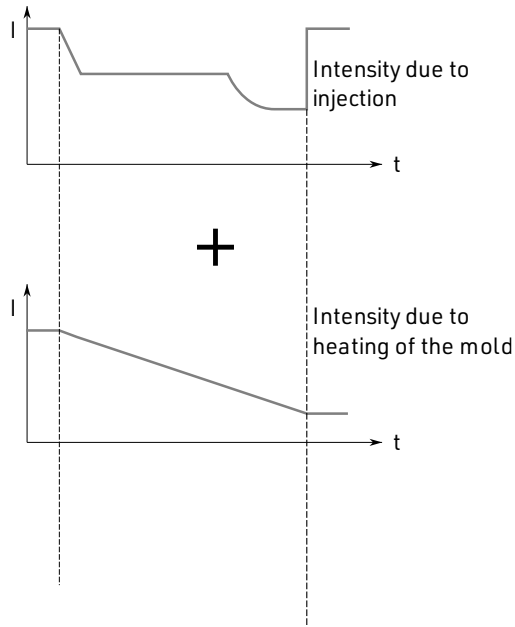


# Metadata Example

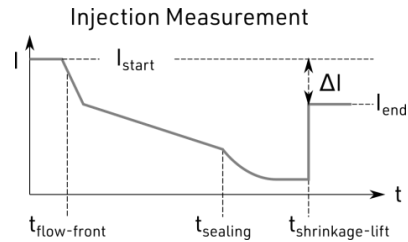
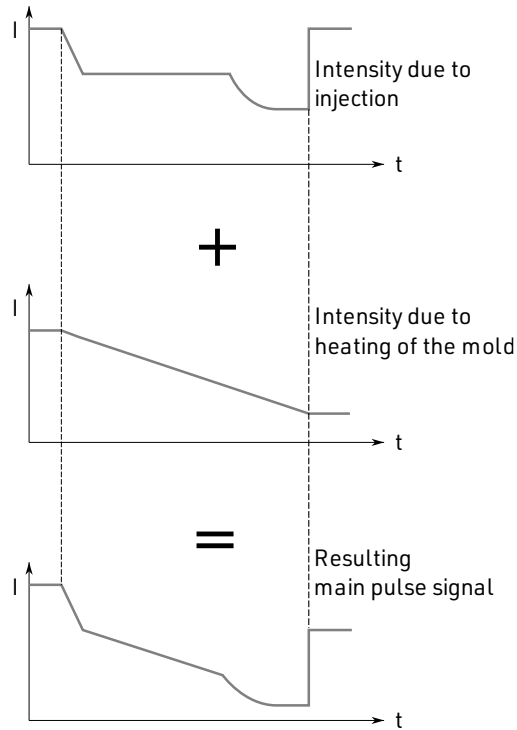




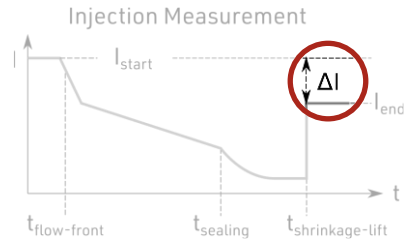
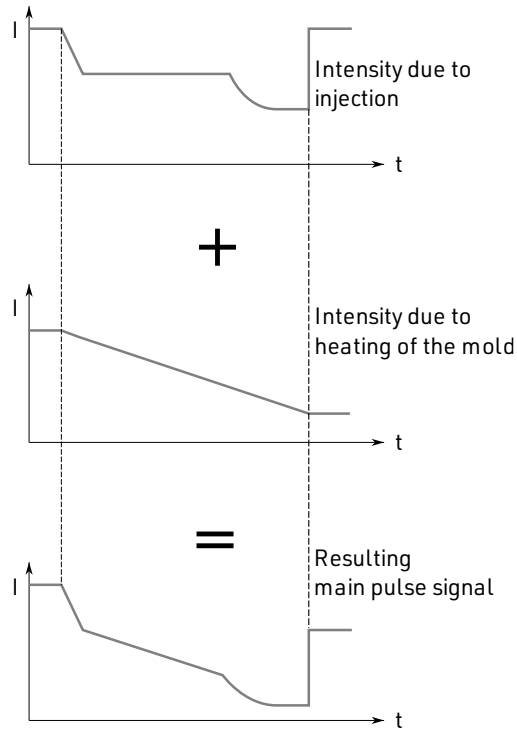
# Metadata Example



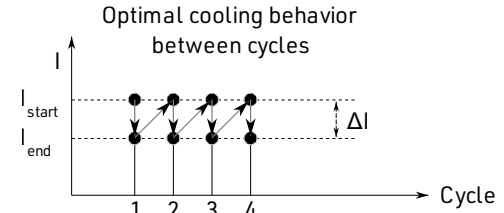
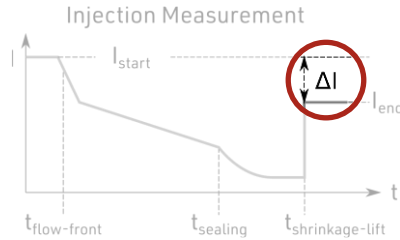
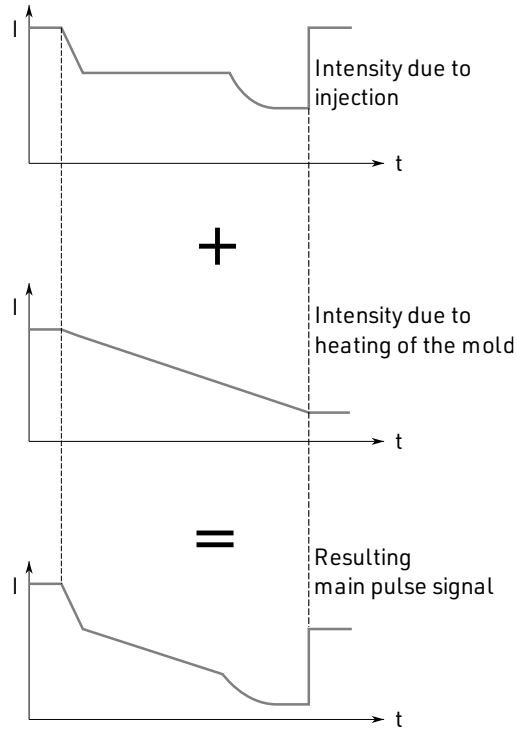
# Metadata Example



# Metadata Example

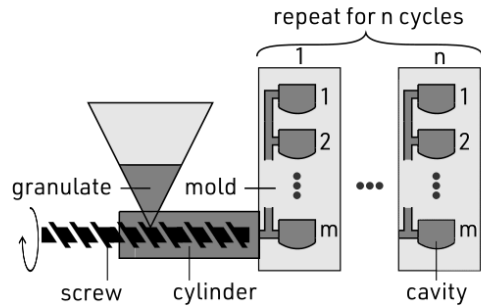


# Metadata Example



# Visualization Workflow

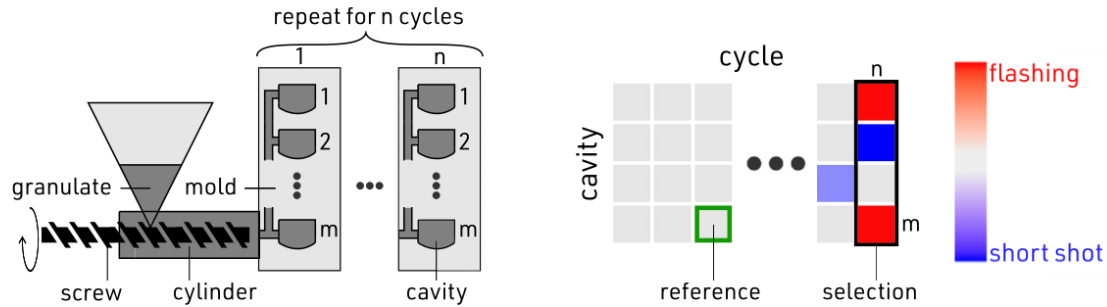
## Injection Cycles



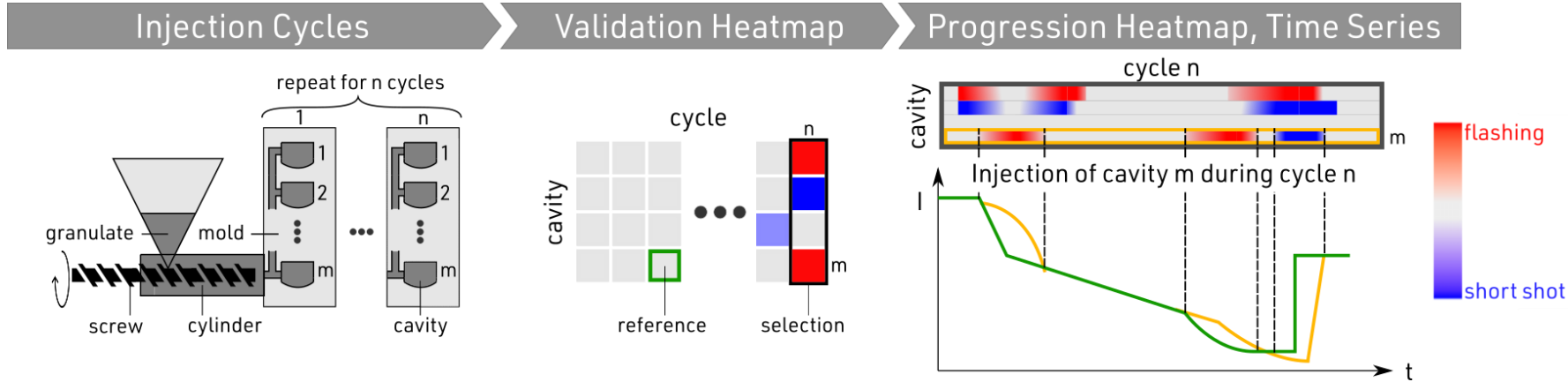
# Visualization Workflow

Injection Cycles

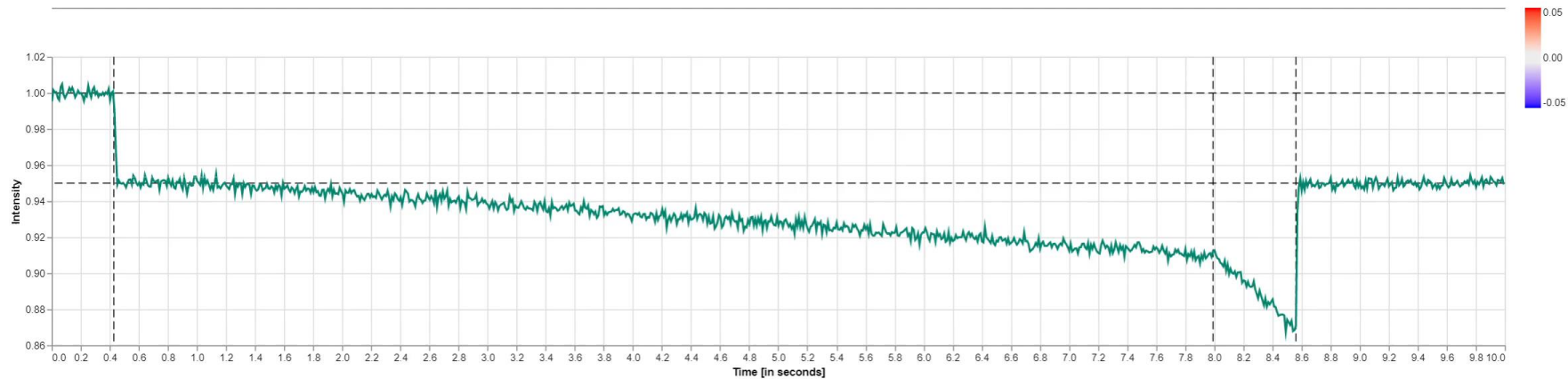
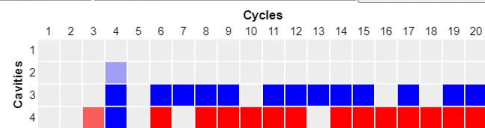
Validation Heatmap



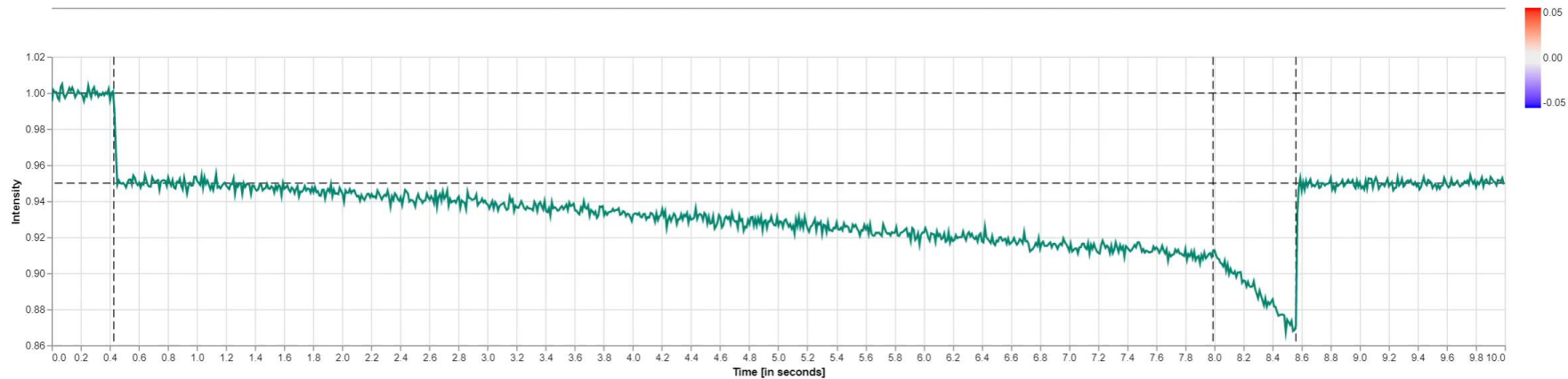
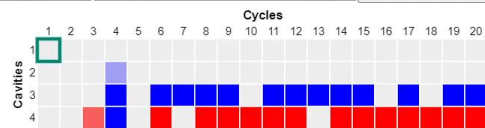
# Visualization Workflow

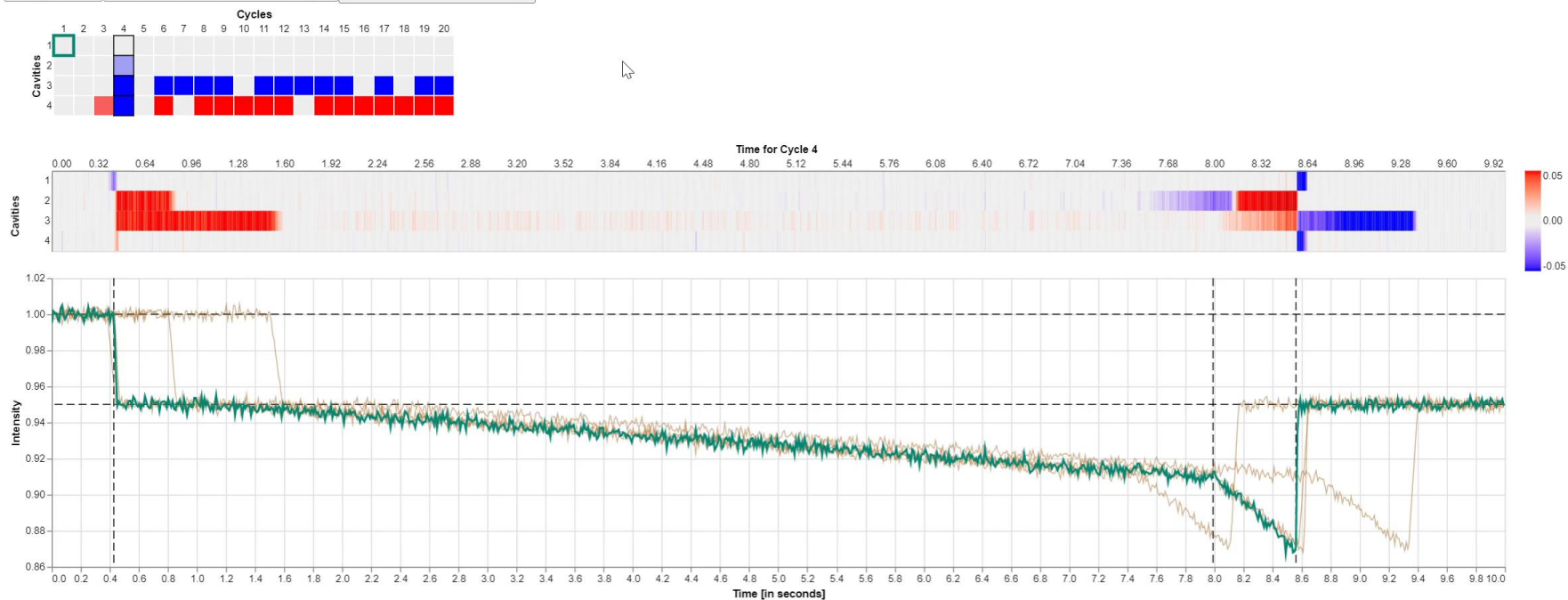


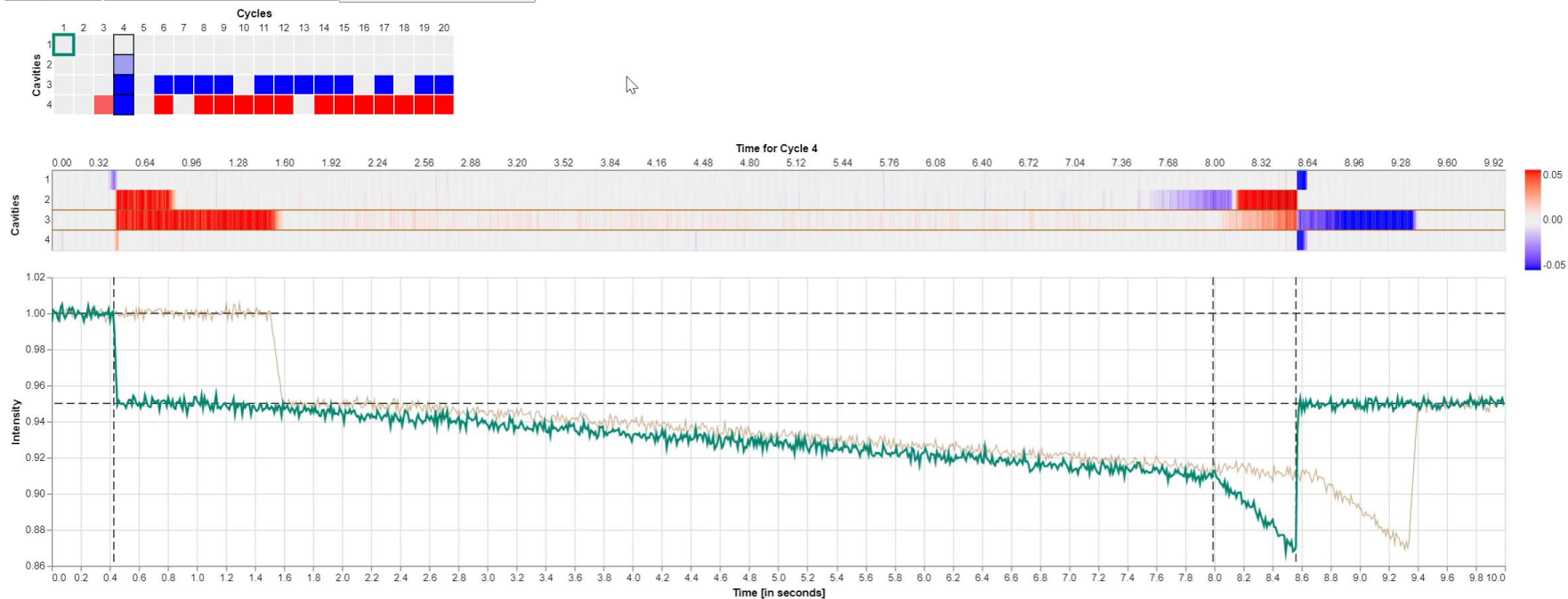
Voltage ▾ Reference 1 ▾ select reference from heatmap



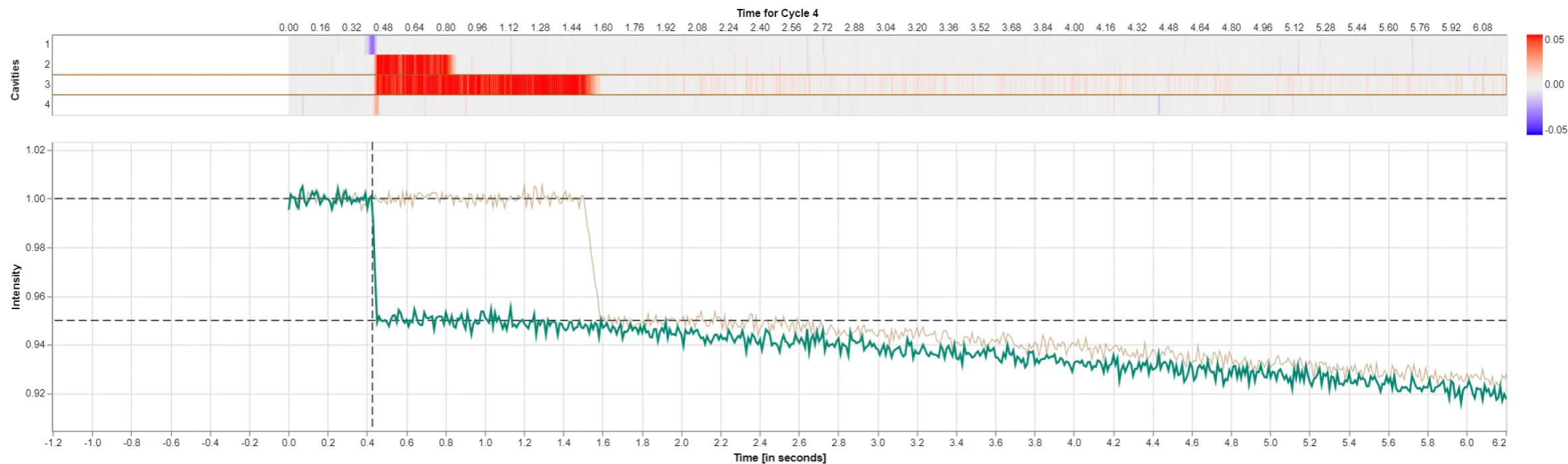
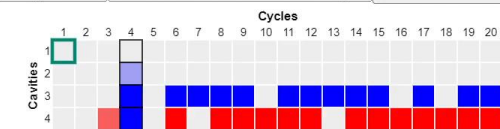


Voltage  Reference from Validation Heatmap 

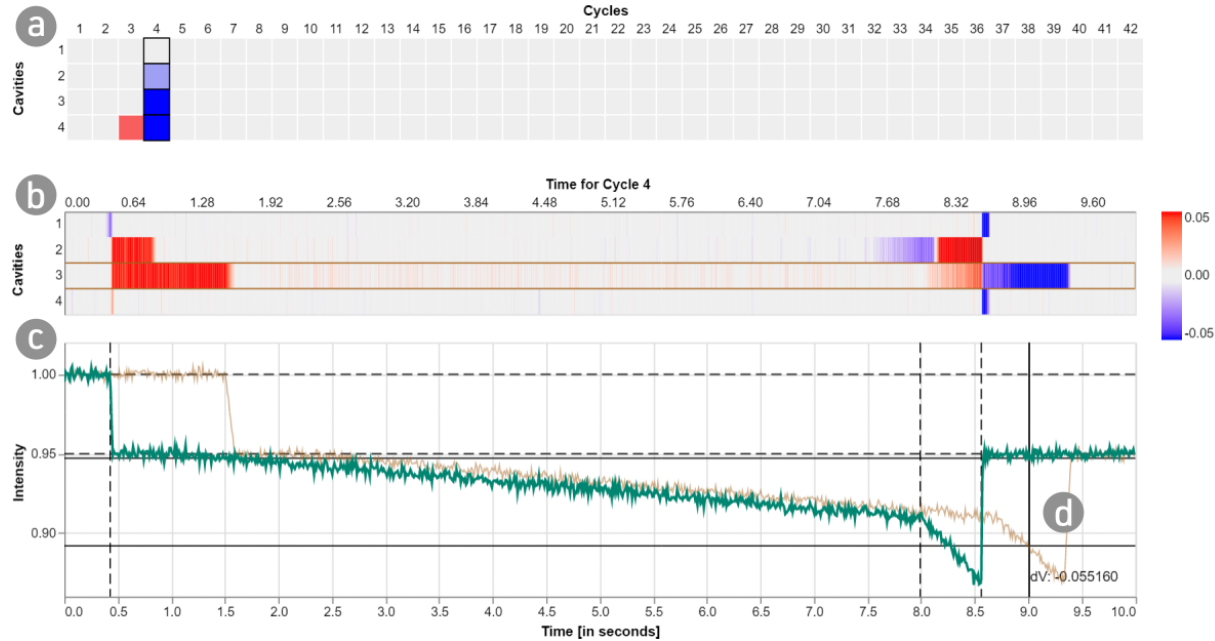
Voltage  Reference from Validation Heatmap  select reference from heatmap

Voltage  Reference from Validation Heatmap 

Voltage  Reference from Validation Heatmap



# Interactive Multi-View Display

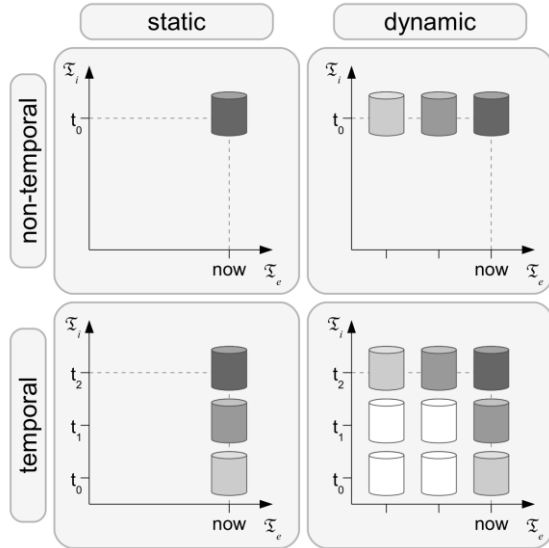


**a** Validation Heatmap   **b** Progression Heatmap   **c** Time Series Plot   **d** Detailed Comparison

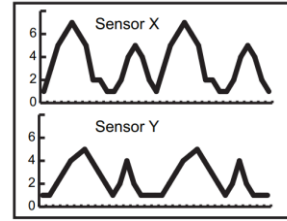
<http://injection-molding.jku-vds-lab.at/>



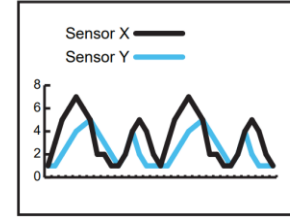
# Related Work, Theory



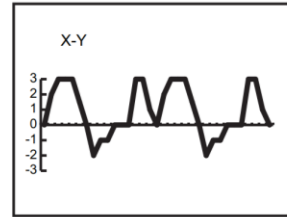
Visualization of Time-Oriented Data  
Aigner et al. (2011)



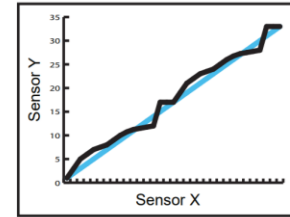
(a) Juxtaposition



(b) Superposition



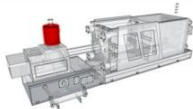
(c) Explicit Encoding: Difference



(d) Exp. Encoding: Time Warp

Considerations for Visualizing Comparison  
Gleicher (2018)

**JYU**



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# Future Work, Generalization

NC Machine



Process of machining a part



Resulting part



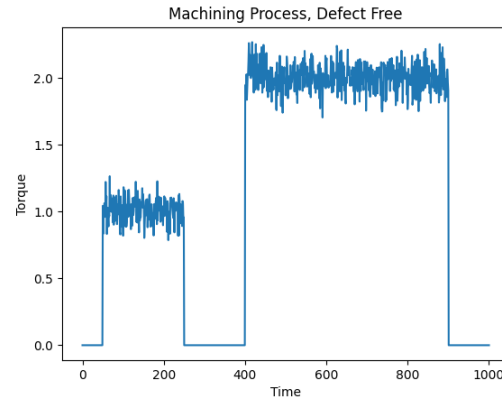


# Future Work, Generalization

NC Machine



Process of machining a part



Resulting part

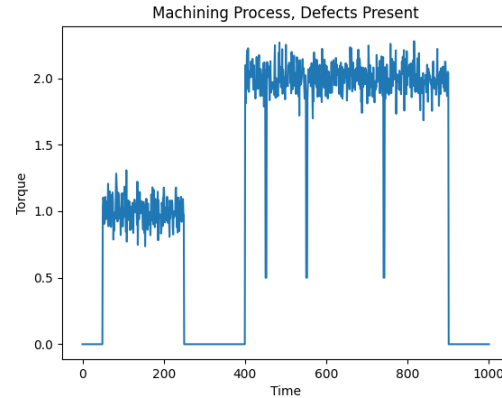


# Future Work, Generalization

NC Machine



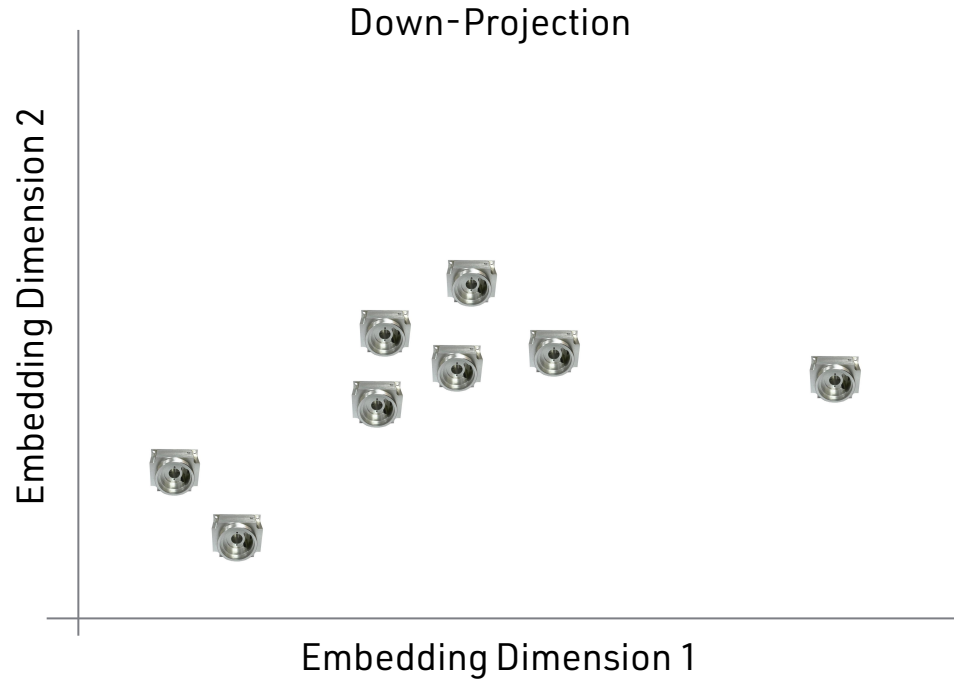
Process of machining a part



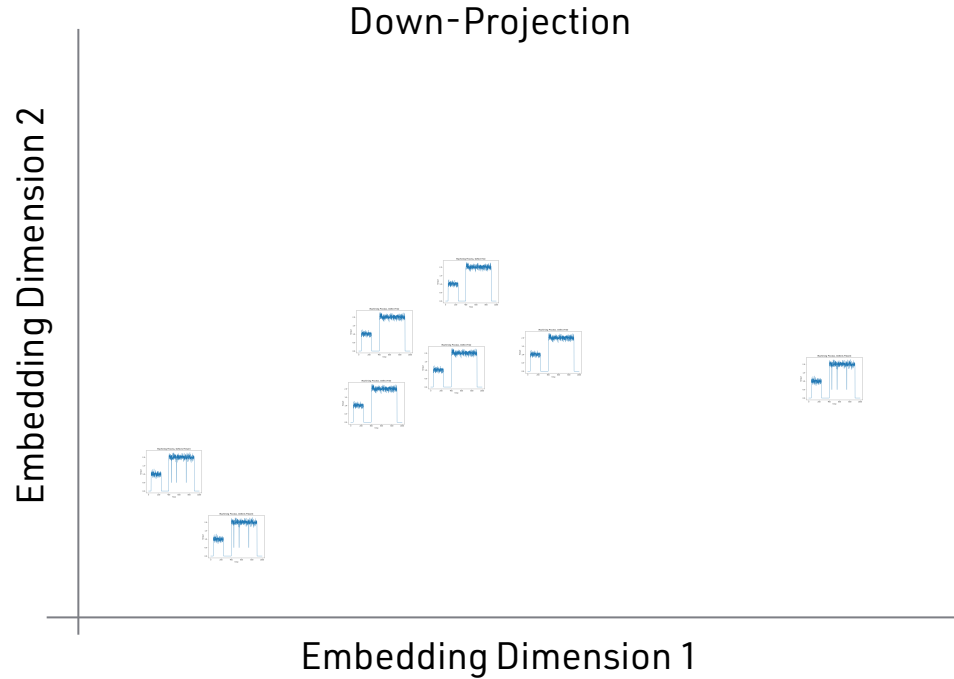
Resulting part



# Future Work, Generalization

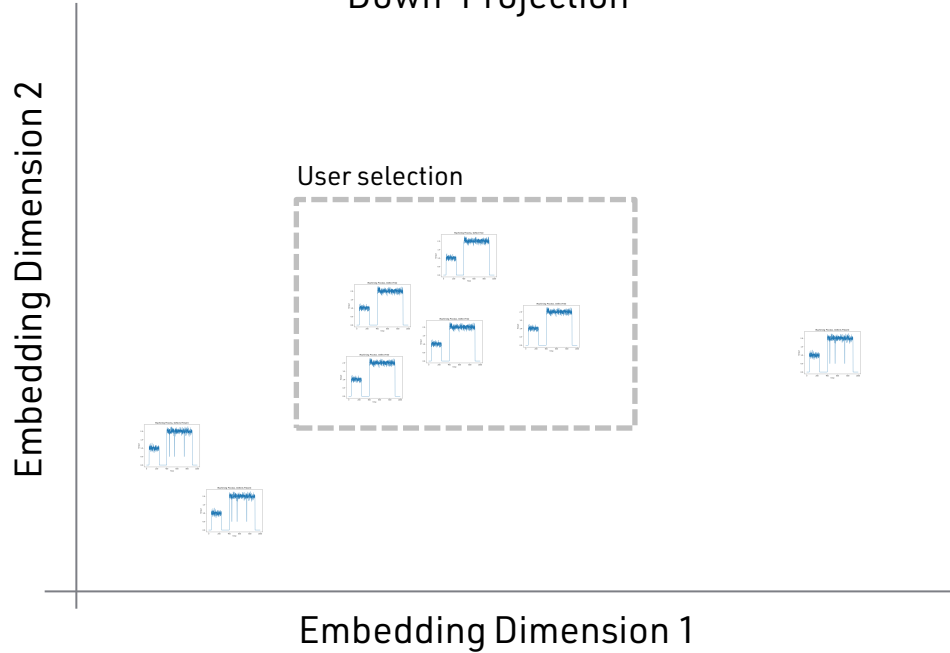


# Future Work, Generalization

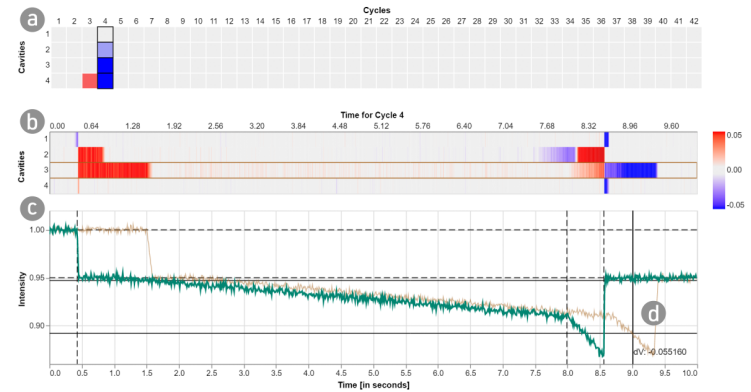


# Future Work, Generalization

Down-Projection



Detail Comparison View



LOAD DATASET

STATES CLUSTERS PROJECTION

Lines

☒ beginner ☒ fridrich

ADVANCED COLORING

Path Length Filter

0 129

Points

shape by

None

☒ + First State

☒ ● Intermediate State

☒ ★ Last State

brightness by

age

size by

multiplicity

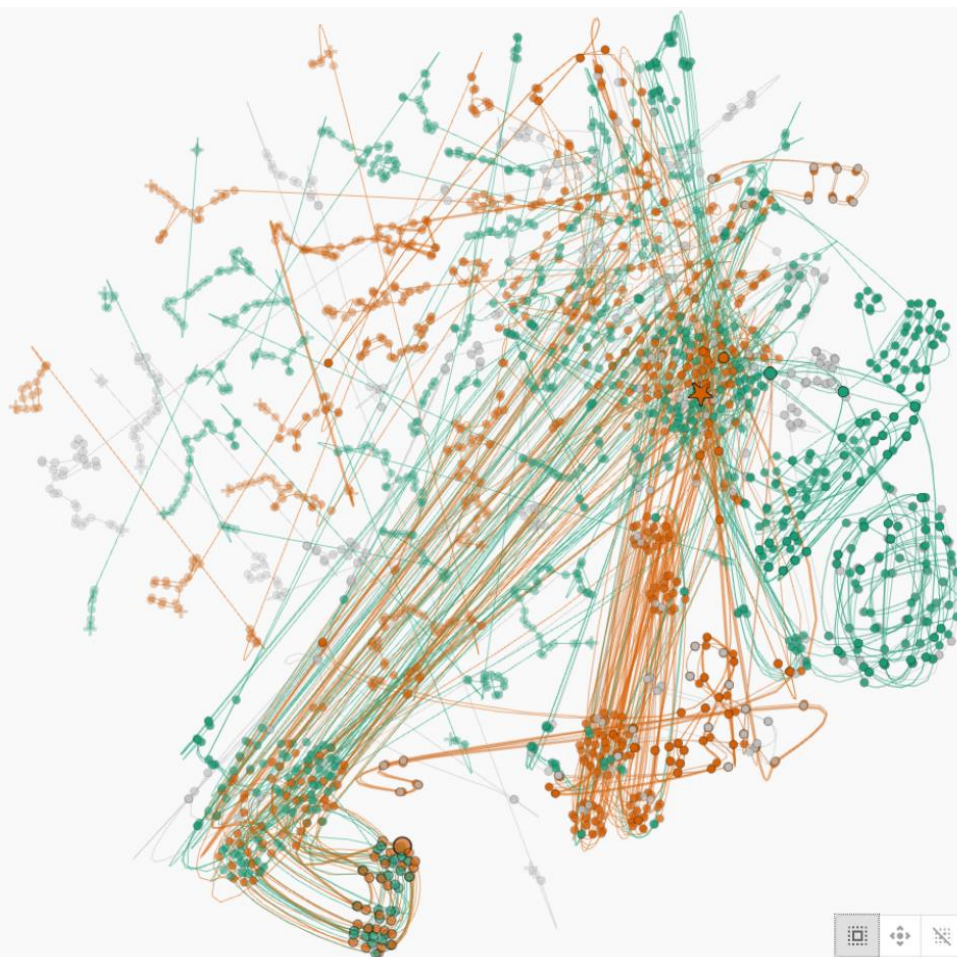
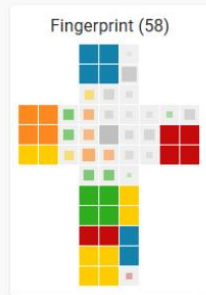
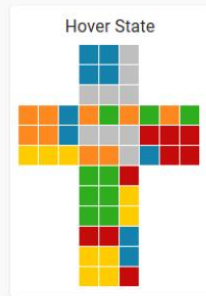
Size Scale

0 1 2 3 4 5

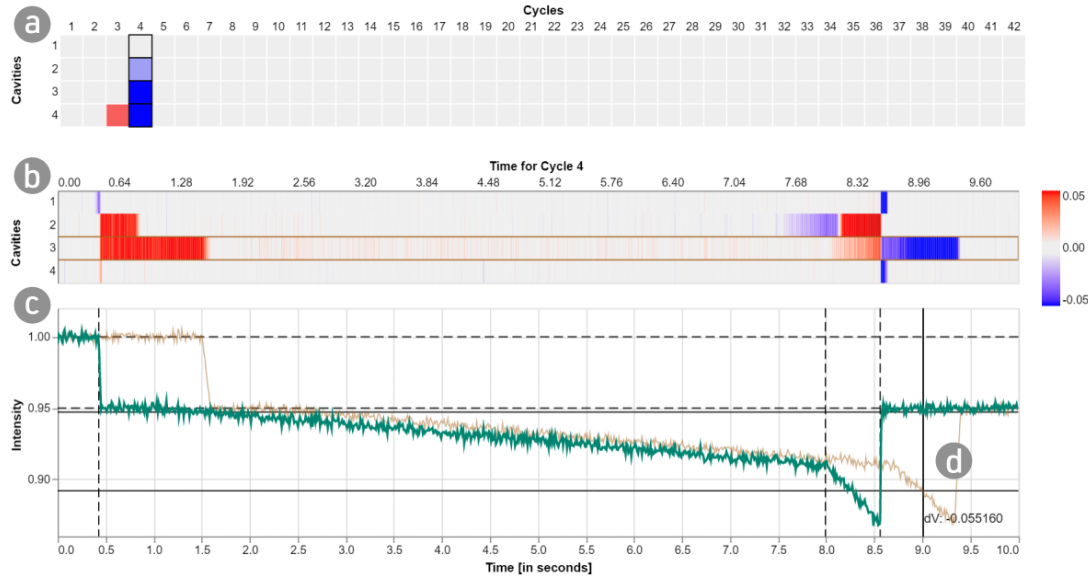
color by

algo

ADVANCED COLORING



# Visualizing and Monitoring the Process of Injection Molding



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