Rule-based color coding

Transferring PMI via colors to downstream processes

Agenda

- Introduction
- General usage of colors within CAD
- Current status of PMI transfer
- Goals of PMI transfer
- Software support
  - Live demo
- Conclusion and future

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- CEO at B&W Software
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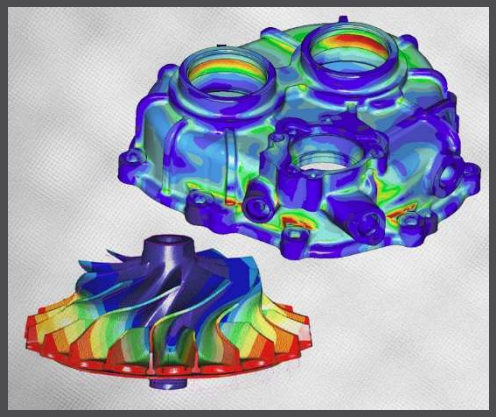
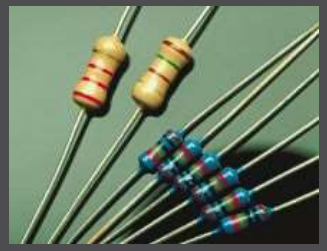
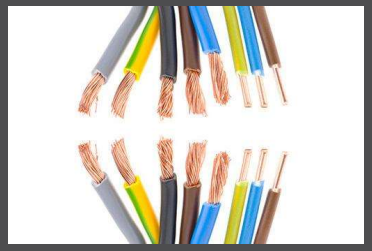
Introduction

- History
  - Traditional usage of colors in technical areas
    - Marking of resistors
    - Marking of cables
    - Marking tubes
    - Analysis results
    - …

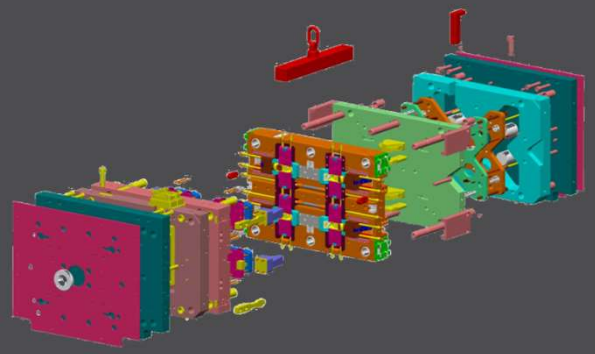


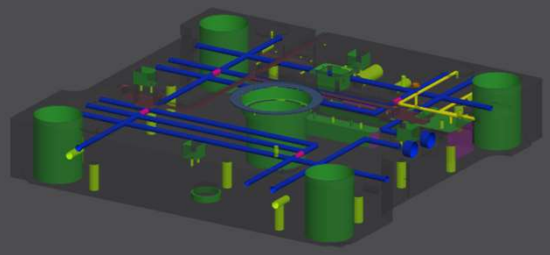




Using colors in CAD

- Design
  - Correct and realistic representation of assembly
  - Design support
  - Improved display of internal geometry



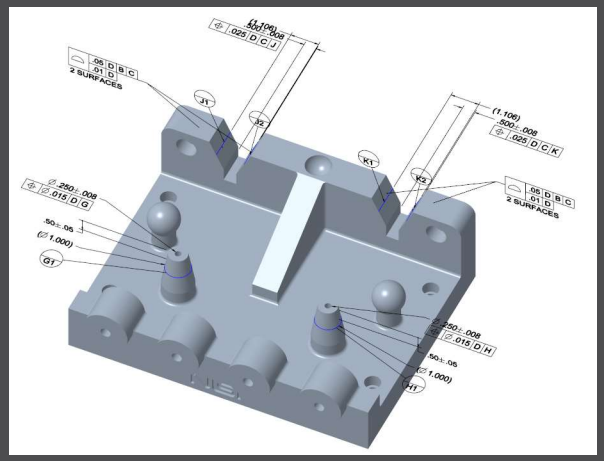


Using colors in CAD

- Documentation and Marking
  - Highlighting areas with a specific property
  - Marking faces with the same manufacturing strategy
  - ….

Using colors in CAD

- Are there use cases in the MBD environment?
  - i.e. transfer of product and manufacturing information (PMI) to downstream processes and functions (Manufacturing, QA, …)
    - Tolerance information, Surface finish properties



Status of PMI transfer

- Often still based on a 2D drawing
  - Stable; dimensional tolerances and GD&T; process automation very hard or impossible
- Change to a 3D approach for automation purposes
  - Often a copy of the traditional way of working in 2D
    - Difficult to apply dimensional tolerances or GD&T (ISO 16792)
    - Alternate means are not used (Videos, colors, AR, …)
  - Transfer of semantic PMI through a neutral interface still instable and not reliable.

Goals of PMI Transfers

- Easy and reliable communication
  - Even via neutral interfaces
  - Crossing department or enterprise borders
- Speeding up the process of transferring PMI
  - Quick application and consumption by humans
  - Direct usage in downstream processes by and machines
    - NC-programming; CMM-programming

Arguments for using colors

- RGB Code unique and widely used
  - (~16 Mio combinations)
- Color application easily feasible in CAD model
- Reliable transferable via neutral interfaces
- Machine readable (semantic)
- Easily understandable and recognizable for humans
  - Though only limited cominations distinguishable

Arguments for using colors

- RGB values are attributes that can be added to faces and quilts.
- They do not need an additional placemnt of a symbol to visualize the properties.

Current limitations

- Slow manual work
- Error prone during selection of faces
- Difficult to manage and export multiple color states
- Can get confusing for human consumption

How can a software tool help?

- Automation
  - Rule sets to support the selection process for faces by
    - Geometry (type, size, orientation, …)
    - Information (parameter, name, …)
    - Container (within UDF, within feature, on layer, …)
  - Color application for selected faces or quilts
    - Automatic for rule sets
    - Manual by user selection

How can a software tool help?

- Visualisation
  - Managing multiple appearance states
  - Adding an associative legend
  - Export control and multiple destination formats

Important reqirements

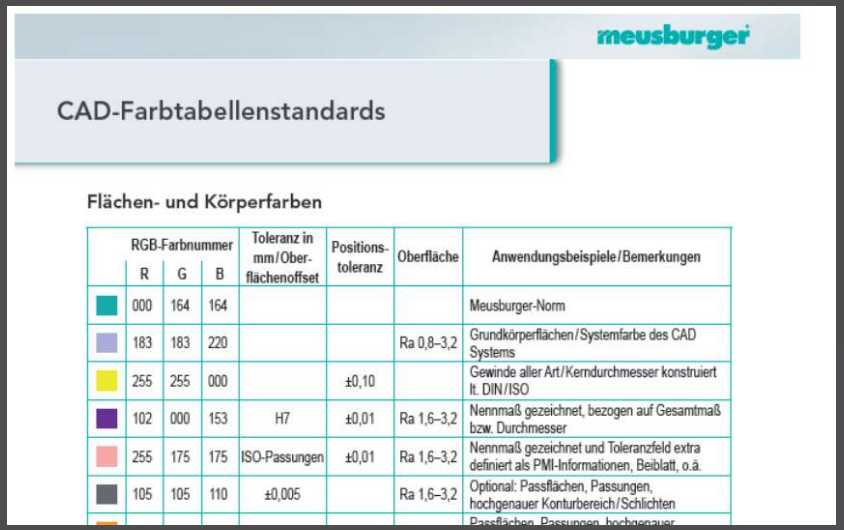
- Additional conditions
  - The model can contain colors already
  - The model will be worked on after an initial color application
  - In some cases rules shall be manually overwritten
  - Multiple color states are necessary
  - Only one specific state shall be exported

Live Demo

- Live Demo

Differentiation

- Can‘t you do this with GD&T?
- Do you need a Datum Reference System?
- Are there any international standards?



meusburger

CAD-Farbtabellenstandards

Flächen- und Körperfarben

RGB-Farbnummer R	G	B	Toleranz in mm/Oberflächenoffset	Positionstoleranz	Oberfläche	Anwendungsbeispiele/Bemerkungen
000	164	164				Meusburger-Norm
183	183	220			Ra 0,8–3,2	Grundkörperflächen/Systemfarbe des CAD Systems
255	255	000		±0,10		Gewinde aller Art/Kerndurchmesser konstruiert lt. DIN/ISO
102	000	153	H7	±0,01	Ra 1,6–3,2	Nennmaß gezeichnet, bezogen auf Gesamtmaß bzw. Durchmesser
255	175	175	ISO-Passungen	±0,01	Ra 1,6–3,2	Nennmaß gezeichnet und Toleranzfeld extra definiert als PMI-Informationen, Beiblatt, o.ä.
105	105	110	±0,005		Ra 1,6–3,2	Optional: Passflächen, Passungen, hochgenauer Konturbereich/Schlichten

Conclusion

- Colors can be easily used to transport a variety of different information
- The Export is reliable and stable even throughout neutral interfaces
- Machines and other software tools can read color codes and automatically use it
- Software support makes sense to speed up color application and reduce errors

Thank you for your attention!!!

Questions?

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