INTERACTIVE 3D-REPRESENTATION OF MATERIAL MATHEMATICAL MODELS WITH WEBGL

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The web project DAMM (Digital Archive of Mathematical Models [1]) at the TU Dresden aims to visualize material mathematical models by means of interactive 3D-representations to enhance the user experience during online investigation. For this purpose we constructed a data framework called "Mediabox", which technically is a structure of files in a directory on the web server. For every 3D-representation there is a Mediabox, containing a standalone presentation with an interface, which as a whole can be loaded by the website. The Mediabox uses HTML, JavaScript, WebGL and other techniques to show 3D-content, and can furthermore be used as a container for the creation of new media content. The efforts made are supporting the preservation of mathematical artefacts as a cultural heritage, foster the dissemination of previously hidden treasures of scientific collections and last but not least enable a new approach to the perception of historical models.

We want to report, how we create content for the Mediabox from digitized models, how the content can be developed and extended with additional virtual data, how several 3D-representations can be linked, how the user interface of the Mediabox supports new investigation techniques, and finally how the user can customize the representation and make use of the data for contexts like education and fine art.

The creation of content for the Mediabox is critically dependent on the material properties of the models. Thus the digitizing process forces a classification of the models in categories like "solid plaster", "transparent and reflecting plastic", "movable and flexible", and "threads in a framework" (Fig. 1).

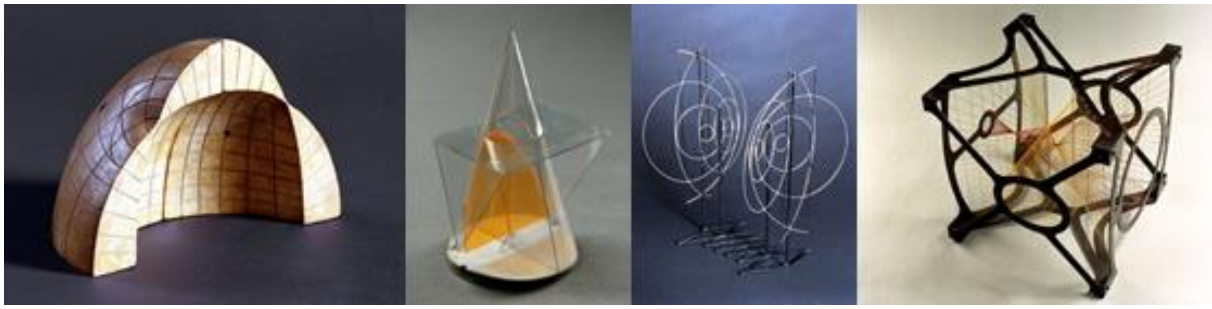

Fig. 1: Examples from the Dresden collection of mathematical models for different material properties.
From left to right: solid plaster, transparent and reflecting plastic, movable and flexible, threads in a framework

Each category demands a different digitizing workflow. In [2] the processing of plaster models is described in depth. We show how additional techniques can be used to create no less accurate digital representations. This is especially relevant for models, which do not fit the scanning process.

The Mediabox was initially created to compensate the absence of the material models during web research. But we are aware of the new possibilities that come within the new technology. The point clouds of the digitized models can for instance be combined with 3D-data from computer algebra systems (Fig. 2). In particular, models can be compared with each other using their 3D-data.

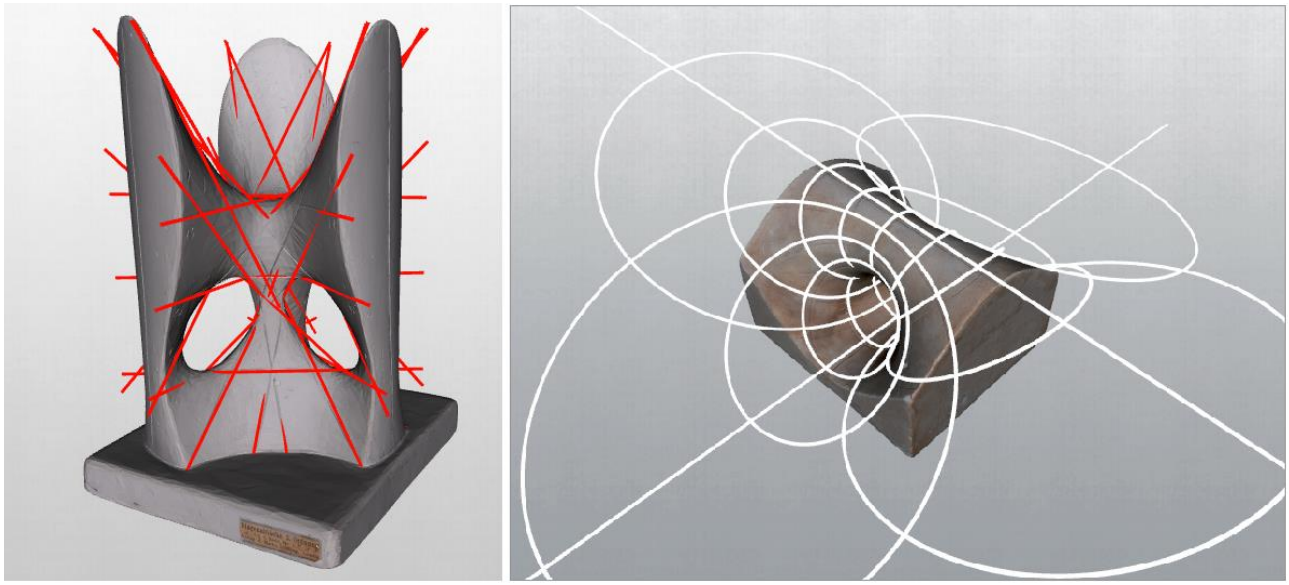

Fig. 2: left: Clebsch surface with 27 lines, right: parabolic ring cyclide with circles

The handling of the models is quite intuitive. Section planes can be inserted and moved by the user in the frontend. In the backend the administrator has a lot of setting options. We will introduce some of these settings by using the powerful X3DOM format [3] to generate the content.

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Keywords: material mathematical models, scientific collection, 3D digitization, WebGL, virtual reality

[1] - https://mathematical-models.org
[2] - https://www.researchgate.net/publication/286935901_AUTOMATED_HIGH_PRECISION_TEXTURING_OF_3D-OBJECTS
[3] - http://www.x3dom.org/examples