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Virtual model of MKS manipulator, part 2: The virtual model

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1 Introduction

Presented abstract describes creation process of virtual model of manipulator for hull integrity inspection (MKS). Described model is result of the model-based design technique. Proposed solution uses two key parts: mathematical model, visualization tool. Resulting virtual model can be use for MIL and SIL simulations as well as base for control design. This paper deals with the visualization and virtual model part.

2 Virtual model - Visualization

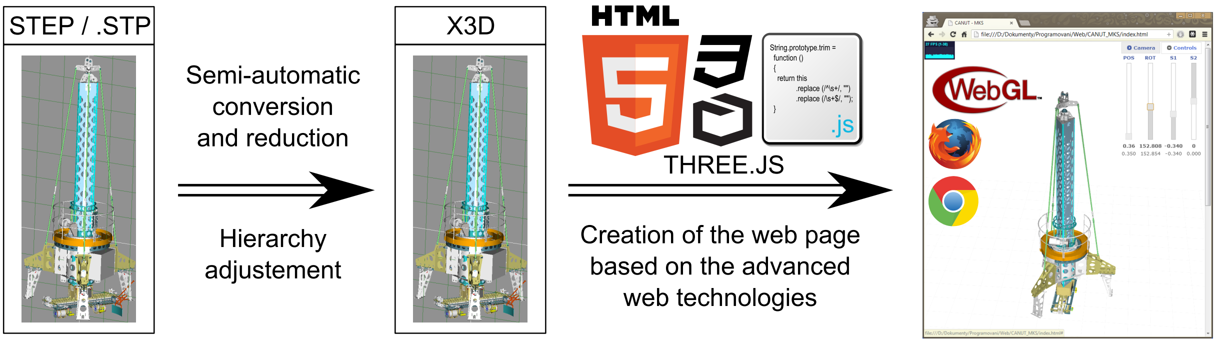

Figure 1: Process of creation of the visualization

Key part of the virtual model of the MKS manipulator is 3D visualization. It uses modern web technologies being today one of the best multi-platform solutions. The main task of the visualization is to truthfully display the state of the mathematical model of the manipulator and allow users to communicate with the model. The description of used technologies follows.

2.1 The 3D model

The whole visualization is based on the 3D model which was exported from CAD (Computer aided design) system. There are several 3D exchange formats, where STEP (Standard for the Exchange of Product model data) is one of the most supported. The main advantages of the STEP format are wide support from various CAD systems and the fact that export preserves model hierarchy. The hierarchy of components of the model is very important especially for animation.

There are several ways how to render 3D objects inside the webpage. Few years ago, the only way how to render 3D was to use third-party plugins such as Java applets [Severa et

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al. (2011)], Adobe Flash plugins or various ActiveX components. Nowadays the WebGL was introduced. This technology allows users to render 3D graphics directly in a webpage without any plugin. WebGL can be directly used from Javascript, but there are also libraries build on top. Project Three.js was used in this case.

The whole web rendering segment is under extensive development, thus described technologies are not fully supported in every web browser. It means that the visualization can be used only in advanced browsers i.e. Google Chrome / Chromium project or Mozilla Firefox

2.2 Communication and RDCWS function block

The visualization uses a new type of the client server architecture. Client (Web Browser) is connected through Socket TCP/IP connection to the special server which translates data from and to the mathematical model. This type of direct webpage communication is called WebSocket. WebSockets are part of the modern web browser technologies called HTML5.

Virtual model is based on communication between visualization and mathematical model. There are two possibilities how to connect models.

In Matlab/Simulink environment an RDCWS (Remote Data Connection via WebSocket) block was created. This function block is part of the mathematical model. It contains 16 inputs and 16 outputs which are communicated with given time period. Data are communicated via text protocol using JSON (JavaScript Object Notation). This type of communication was used only between visualization and MKS Matlab/Simulink mathematical model.

Different approaches were used during simulation in the REX environment [Balda et al. (2005)]. Unlike the Matlab/Simulink case, all signals in REX environment are accessible through RexWS server. RexWS (also based on the *libwebsocket* library) is a tool which provides translation from vendor specific binary protocol to the WebSocket / JSON text protocol. Thus RexWS JavaScript client can be used to connect each part of the visualization to the mathematical model directly.

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References

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