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A Case Study for Modeling Machine Tool Systems Using Standard Representation

Maja Barring and Björn Johansson

Chalmers University of Technology, Sweden

Guodong Shao and Moneer Helu

National Institute of Standards and Technology (NIST), USA



Maja Barring

PhD Candidate

Chalmers University of Technology

Guest researcher at NIST autumn 2019
when the work and paper was developed.

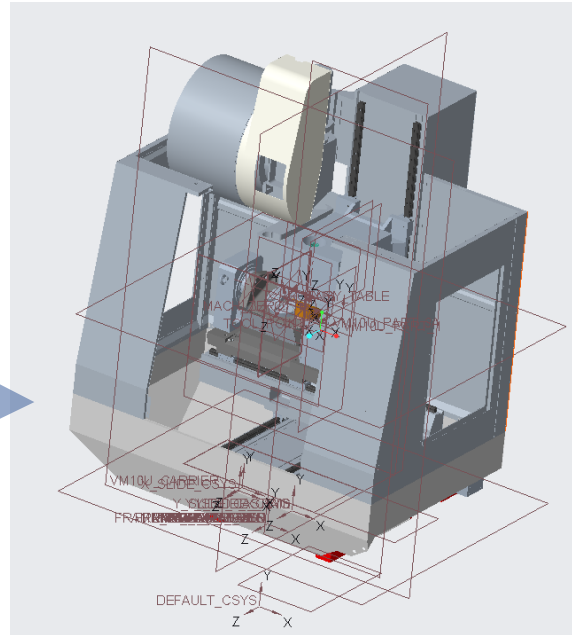
Session: Invited Paper



The Problem

A **machine model** of machine tool system including information about **geometry** and **kinematics**

Various **proprietary** format in **CAX**



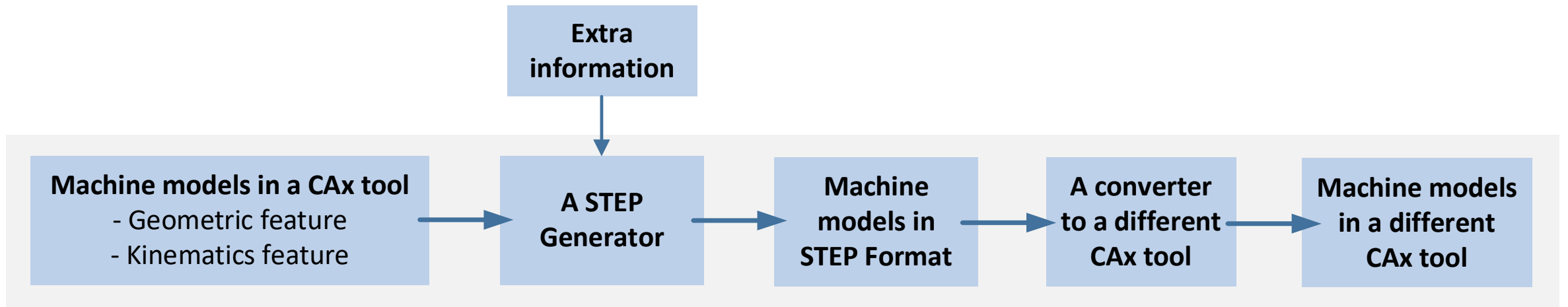
Relevant Standards and Related Efforts

- ❑ ISO 10303 - Standard Exchange of Product Data (STEP)
 - ❑ EXPRESS modelling language
 - ❑ Part21/p21 files
 - ❑ Application Protocols (AP)
 - ❑ AP 242 – kinematics, geometry, and assembly models
- ❑ ASME B5.59
 - ❑ eXtensible Markup Language (XML)
 - ❑ Capabilities and performance of a machine tool

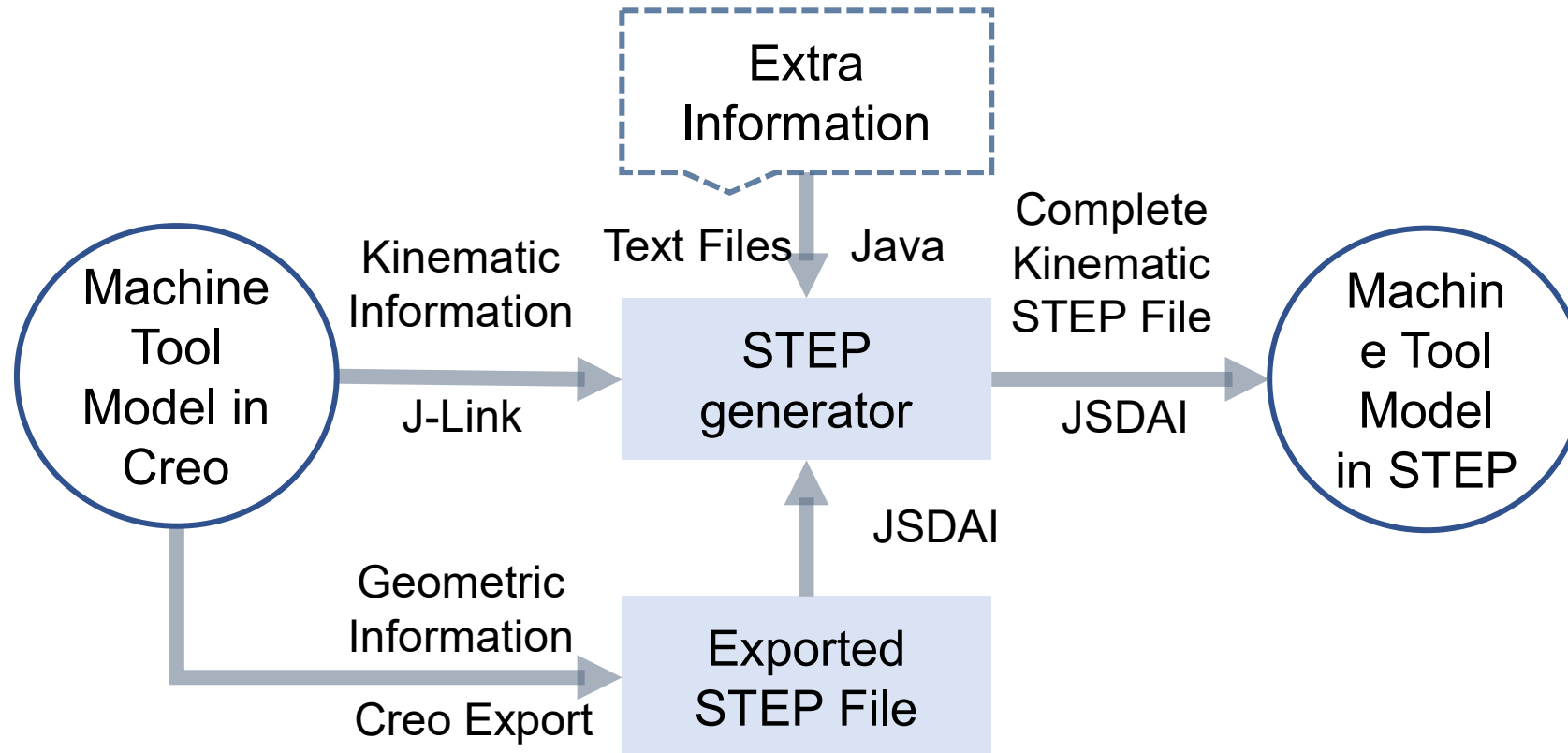
Various **proprietary** format in **CAx**



An Approach for Converting Machine Models

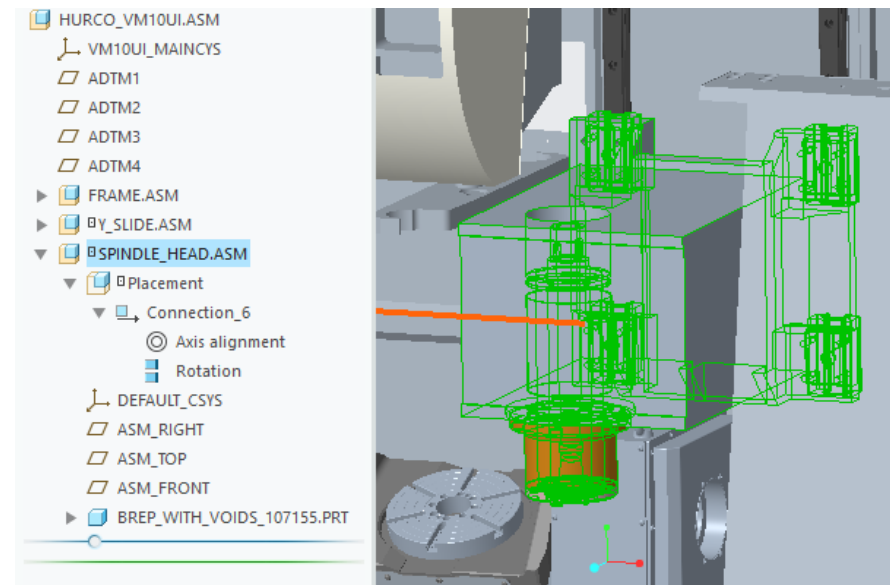
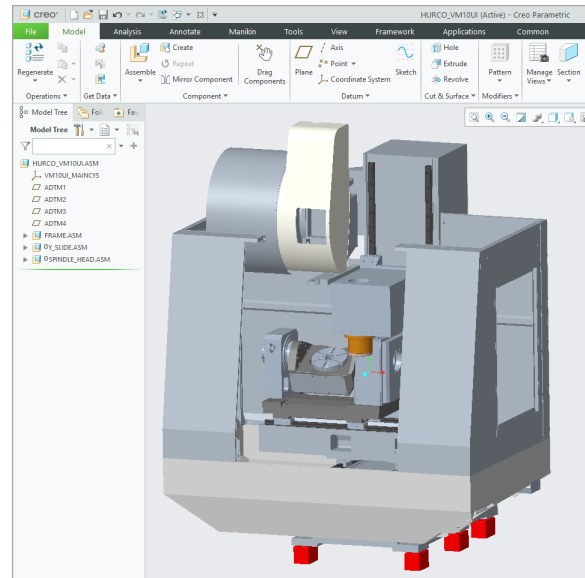


A Case Study – A STEP Generator for PTC Creo



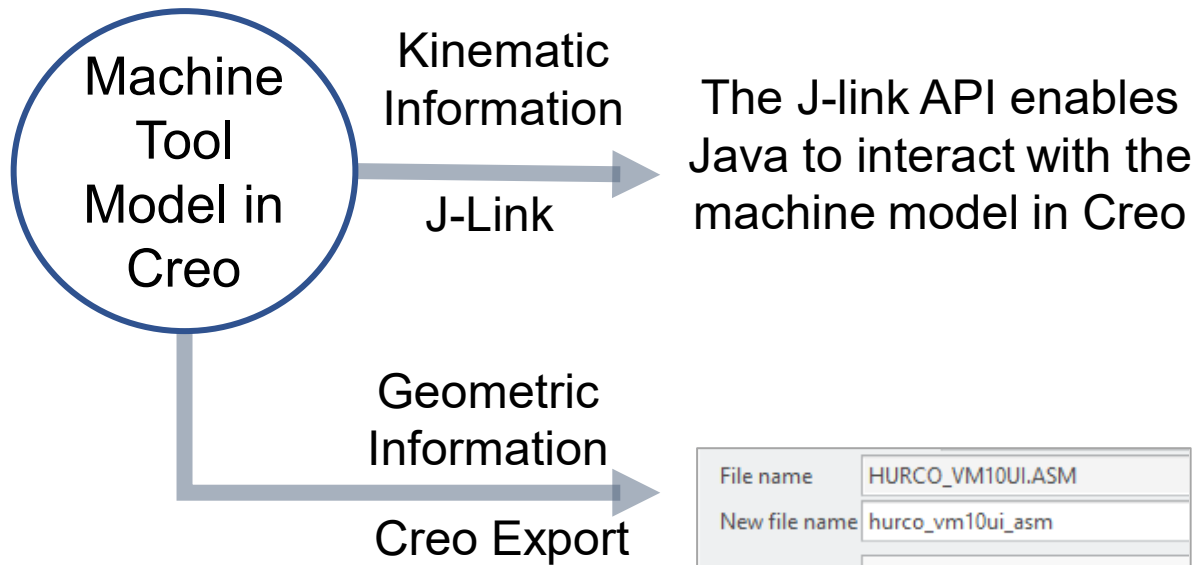
Machine Tool Model in Creo

A machine model of Hurco VM10UI in Creo Parametric



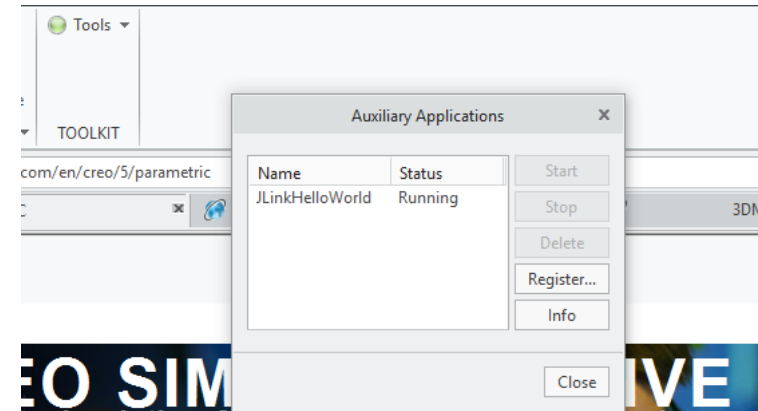
Visualizing the kinematics of a machine tool system

Exporting Machine Model from Creo



The J-link API enables Java to interact with the machine model in Creo

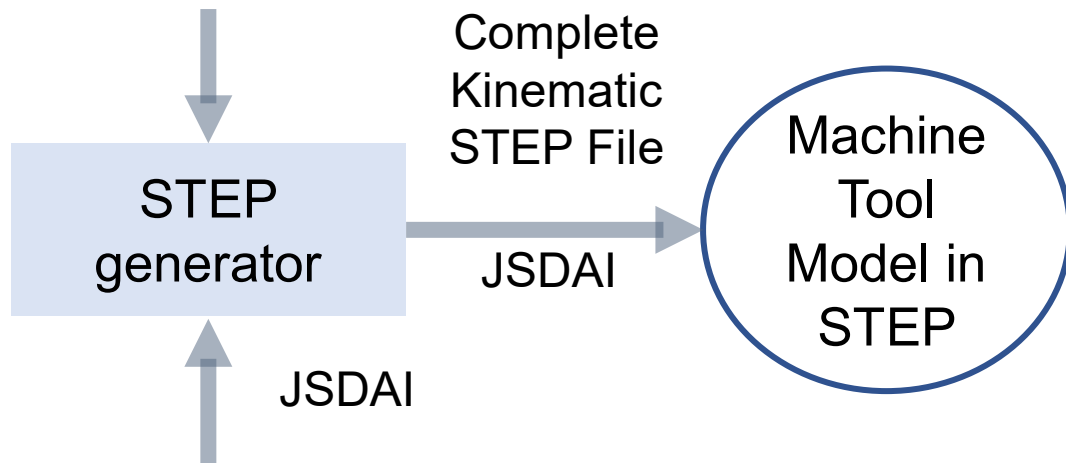
File name	HURCO_VM10UI.ASM
New file name	hurco_vm10ui_asm
Type	STEP (*.stp)



```
hurco_vm10ui_asm_prof.stp - Notepad
File Edit Format View Help
ISO-10303-21;
HEADER;
FILE_DESCRIPTION('', '2;1');
FILE_NAME('HURCO_VM10UI_ASM', '2019-10-08T15:57:32', ('m vb1'), (''),
'CREO PARAMETRIC BY PTC INC, 2019010', 'CREO PARAMETRIC BY PTC INC, 2019010', '');
FILE_SCHEMA('CONFIG_CONTROL_DESIGN');
ENDSEC;
DATA;
#2=DIRECTION('', (0.E0, -1.E0, 0.E0));
#3=VECTOR('', #2, 2.0999999999997E1);
#4=CARTESIAN_POINT('', (-2.88E2, 5.367064179908E2, -7.709115937861E2));
#5=LINE('', #4, #3);
#6=DIRECTION('', (-1.E0, 0.E0, 0.E0));
#7=VECTOR('', #6, 6.59E2);
#8=CARTESIAN_POINT('', (-2.88E2, 5.157064179909E2, -7.709115937861E2));
#9=LINE('', #8, #7);
#10=DIRECTION('', (0.E0, 1.E0, 0.E0));
#11=VECTOR('', #10, 2.0999999999997E1);
#12=CARTESIAN_POINT('', (-9.47E2, 5.157064179909E2, -7.709115937861E2));
```


Integrating Geometrical and Kinematics Information from the Creo Model into a Complete STEP Machine Model

JSDAI provides EXPRESS schemas for AP 242



```
1 ISO-10303-21;
2 HEADER;
3 /* Generated by software containing
4  * JSDAI (TM) from LKSoft (www.lksoft.com, www.jsdai.net)
5  * JSDAI Runtime Version 4.3.0 2011-12-15T17:41:51
6  * JSDAI XIM Full Library Version 1.130.500 2012-10-11T11:19:20
7  */
8 FILE_DESCRIPTION(
9  /* description */ ('Example program to generate a p21 file with xml data as input'),
10 /* implementation_level */ '2;1');
11 FILE_NAME(
12 /* name */ ' ',
13 /* time_stamp */ '2019-10-31T14:29:30',
14 /* author */ ('mvb1'),
15 /* organization */ ('NIST'),
16 /* preprocessor_version */ ' ',
17 /* originating_system */ 'JSDAI MULTIPLE Version 4.0.0 (Build 270, 2011-12-15T17:42:4',
18 /* authorization */ 'mvb1');
19 FILE_SCHEMA(('AP242_MANAGED_MODEL_BASED_3D_ENGINEERING_MIM'));
20 ENDSEC;
21 DATA;
22 #1=APPLICATION_CONTEXT('CONFIGURATION MANAGEMENT');
23 #2=APPLICATION_PROTOCOL_DEFINITION('INTERNATIONAL STANDARD', 'AP242_MANAGED_MODEL_BASED_
24 2019,#1);
25 #3=MECHANICAL_CONTEXT('AP242_MANAGED_MODEL_BASED',#1,'MECHANICAL');
26 #4=PRODUCT('TestID','TestName','TestDescription',(#3));
27 #5=KINEMATIC_LINK('33233');
```

Conclusions and Future Work

- ❑ A **general approach** has been developed for how kinematic and geometrical data can be extracted to a neutral format.
- ❑ A **case specific** setting was explained, including a description of the interfaces and software that were used.
- ❑ The case study serves as a **feasibility study** and demonstrates step-by-step how this can be done.
- ❑ Real industrial impact for enabling **better information reuse, better interoperability, and more consistent management.**
- ❑ Supports **decision-making** throughout the **lifecycle** of a production system.
- ❑ **Future work:** more studies and CAx adapters

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Thank you!

Maja Barring
maja.barring@chalmers.se

