Czech Technical University in Prague
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Automated Testing of Models of Cyber-Physical Systems

by

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Abstract

Area of verification...

Keywords:
keyword1, keyword2, keyword3, keyword4, keyword5.

Acknowledgement

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Abbreviations

General[TODO delete if no other cathegory]

CPS	Cyber-Physical System
MBD	Model-based design
$\mathbb{Z}_m$	Least nonzero residue number set with a module of m
$\mathbb{S}_m$	Symmetric residue number set with a module of m
$\mathbb{Q}$	Rational numbers set
$\mathbb{F}_t$	Floating point numbers set with a precision of t
$\mathbb{R}$	Real numbers set

Common Mathematical Functions and Operators

10_2	Numbers' radices are designated with a subscript
$\mathbf{b}$	Vector $\mathbf{b}$
b_i	the i^{th} element of vector $\mathbf{b}$
$\|\|\mathbf{b}\|\|$	Norm of vector $\mathbf{b}$
$\dim \mathbf{b}$	Dimension of vector $\mathbf{b}$
$\mathbf{A}$	Matrix $\mathbf{A}$
$a_{i,\,j}$	Element of matrix $\mathbf{A}$ at the i^{th} row, and the j^{th} column
$\mathbf{A}^{-1}$	Inverse matrix to matrix $\mathbf{A}$
$\mathbf{A}^T$	Transposed matrix to matrix $\mathbf{A}$
$\|\|\mathbf{A}\|\|$	Norm of matrix $\mathbf{A}$
$\operatorname{cond} \mathbf{A}$	Condition number of matrix $\mathbf{A}$
$\operatorname{rank} \mathbf{A}$	Rank of matrix $\mathbf{A}$ — how many independent rows/columns it has
$\max\{a,\, b\}$	Maximum of a and b, a when $a \geq b$, b when $a < b$
$\min\{a,\, b\}$	Minimum of a and b, a when $a \leq b$, b when $a > b$
$O(x)$	The big O notation
$\Theta(x)$	The big Θ notation

Mathematical Terminology

Q	Number of prime number modules
M	A product of individual modules $M = \prod_{i=1}^{Q} m_i$
...	...
...	...
...	...
...	...

Miscellaneous Abbreviations

FPU	Floating Point Unit
...	...
...	...
...	...
...	...

Chapter 1

Introduction

At the beginning of the 21.st century human race enters into a new era of industrial revolution generally called Industry 4.0[TODO citation]. Until now humans used computers and automation to make industrial processes as efficient as possible. But now technology allowed us to create Cyber-Physical Systems (CPS) and integrate them into the industrial process. All the work can be handeled by fully autonomous devices that man will only oversee thus giving us more space for something humans do the best, intellectual creativity. But if we are to put all the work on CPS, we must make sure that such devices will be as safe and secure as possible.

1.1 Motivation

Especially nowadays when creation of CPS is still very expensive, we desperately need an efficent metodology for such task. Many companies all over the world use Model-based design (MBD) for prototyping and enhancing their products. MBD puts narurally a lot of emphasis on the creation of digital model of CPS. An important part of such process is model verification. Usually an engineer has a list of requirements that CPS must comply in order to be considered as safe an secure. Manual process of verification of models of CPS is very time consuming and limited. Several verification tools have been developed to address this issue by running automated tests against a set of requirements in a Simulation. These tools usually use complex search algorithms to find a simulation trace that violates given requirement(s). It is not a trivial task and in addition such tools treat models only as black box, not considering its inner structure. This approach thus have its limitations and that is why we propose new algorithms for automated testing of models of CPS with consideration of their inner structure.

1.2 Problem Statement

Brief description of the topic of the report. A complete explanation of the topic shall be described within chapter 2 at page 4.

1.3 Related Work/Previous Results

Briefly.

1.4 Structure of the Report

The report is organized into ... chapters as follows:

1. *Introduction*: Describes the motivation behind our efforts together with our goals. There is also a list of contributions of this report.

2. *Background and State-of-the-Art*: Introduces the reader to the necessary theoretical background and surveys the current state-of-the-art.

3. *Overview of Our Approach*: ...

4. *Prelimitary Results*: ...

5. *Conclusions*: Summarizes the results of our research, suggests possible topics of your doctoral thesis and further research, and concludes the report.

Chapter 2

Background and State-of-the-Art

...

2.1 Theoretical Background

2.2 Previous Results and Related Work

Chapter 3

Overview of Our Approach

The sample Fig. 3.1 shows ...

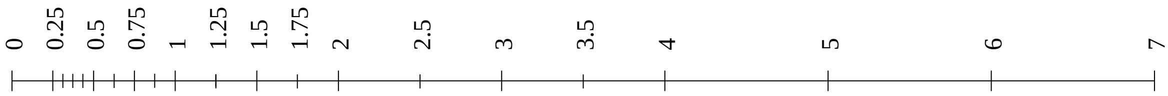

Figure 3.1: Distribution of the floating point numbers. This figure shows a distribution of a sample floating point number set with a precision $t = 3$, and $e_{min} = -1$ and $e_{max} = 3$.

There are two basic floating point data types , as defined by the IEEE 754-2008 [1] standard, are shown in Tab. 3.1.

	Sign [b]	**Exponent** [b]	**Mantissa** [b]	**Prec.** [dig]	**Total** [b]
binary32	1	8	24	8	32
binary64	1	11	53	16	64

Table 3.1: Basic floating point data types.

Chapter 4

Prelimitary Results

4.1 Prelimitary Result 1

4.2 Prelimitary Result 2

4.3 Prelimitary Result 3

4.4 Discussion

4.5 Summary

Chapter 5

Conclusions

5.1 Proposed Doctoral Thesis

Title of the thesis:
TITLE
The author of the report suggests to present the following:

5.1.1 Topic 1

5.1.2 Topic 2

5.1.3 Topic 3

Bibliography

[1] IEEE Computer Society Standards Committee. *IEEE Standard for Floating-Point Arithmetic*. ANSI/IEEE STD 754-2008. The Institute of Electrical and Electronics Engineers, Inc., 2008.

Publications of the Author

[A.1] R. Gortz, F. Tölökö. *On the Carpathian Castle.* Transylvanian Journal of ..., Werst, Romania, 2010.

The paper has been cited in:

- Š. Nováků. *Carpathian Castle Revealed*, International Symposium on Carpathian Legends, 1:319–323, 2010.

[A.2] R. Gortz *Another publication.* 36$^{\text{th}}$ International Conference on ..., pp. 19-24, Štrbské pleso, Slovak Republic, 2010.

Appendix A

...

A.1 ...

Section not in the Table of Contents