Dr. rer. nat. Nenad Balanesković, Blauenstraße 21, 60528 Frankfurt/M,

Tel: +49 (0)15221794546 or +49 (0)1758104448, E-Mail: balaneskovic@gmx.net

Curriculum Vitae

Personal Information

Date of birth:	May 14th 1984
Place of birth:	Nis, Serbia
Marital status:	married

- sociable
- didactical and negotiation skills
- empathic
- cooperative

My Aims

- Participation in diversified data science and AI projects
- Use of software development techniques already acquired at the university and in industry (Python, MATLAB, C#, C++)
- Professional software development of Windows applications with Python, R, MATLAB and Visual Studio Code
- Permanent education in the domains AI, Data mining, machine learning and algorithm development

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Education

(see also: https://github.com/NenadBalaneskovic)

2016	**Promotion** at the TU Darmstadt (*magna cum laude*); Thesis: »*Random Unitary Operations and Quantum Darwinism*«. University Library of the TU Darmstadt (link): http://tuprints.ulb.tu-darmstadt.de/5148/
2011 - 2016	Doctoral studies in Physics (PhD) at the TU Darmstadt. Research sector: **Quantum Information Theory and Quantum Computers**
2008 - 2011	**Master-Studies** in Physics (MSc.) at the TU Darmstadt; Thesis: »*Nonequilibrium and the Functional Renormalization Group*«.
2005 - 2008	**Bachelor-Studies** in Physics (BSc.) at the TU Darmstadt; Thesis: »*Nonequilibrium Initial Conditions for Plasma Instabilities*«.
2000 - 2005	Grammar School »Carl-Schurz-Schule« in Frankfurt/M; Certificate: **Abitur** (university entrance qualification)

Teaching experience

2015 - 2016: TU Darmstadt	**Coordination of tutoring sessions and exams**, Lecture »*Classical Mechanics*«
2015: TU Darmstadt	**Coordination of tutoring sessions**, Lecture »*Theoretical Quantum Optics*«
2014: TU Darmstadt	May-August, supervisor of the **Bachelor-Thesis** of Marc Mendler
2013: TU Darmstadt	May-August, supervisor of the **Bachelor-Thesis** of Felix Weber
2012 - 2013: TU Darmstadt	**Coordination of tutoring sessions and exams**, Lecture »*Classical Mechanics*«
2012: TU Darmstadt	**Coordination of tutoring sessions and exams**, Lecture »*Quantum Mechanics*«
2011 - 2012: TU Darmstadt	**Coordination of tutoring sessions and exams**, Lecture »Electrodynamics«
2011: TU Darmstadt	**Tutoring sessions**, Lecture »*Introduction to Theoretical Physics*«
2010: TU Darmstadt	**Teaching Award** of the Gerhard Herzberg Gesellschaft
2010: TU Darmstadt	**Tutoring sessions**, Lecture »*Quantum Mechanics*«
2009 - 2010: TU Darmstadt	**Tutoring sessions**, Lecture »*Classical Mechanics*«
2002 -	Private Tutoring for Grammar school students in physics and mathematics

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Professional Experience

01. 01. 2023 - 31. 05. 2024	nexonar hardware development (Desoutter & Atlas Copco Group) - Design of a new infra-red tracker form
01. 04. 2022 - 31. 05. 2024	GUI development (Desoutter & Atlas Copco Group) - PyQt5-GUI for the automated camera calibration
01. 12. 2021 - 31. 03. 2022	MQTT-projects (Nissan, BMW, Airbus) - Automation of lens apperture adjustments
01. 05. 2021 - 31. 05. 2024	Cloud-based automation of camera validation (Atlas Copco Group) - Google Apps Script implementation of the camera validation procedure
01. 09. 2019 - 30. 09. 2019	Faurecia ArtIFIS Project - ML-driven movement control of the robotic agent (ironing and steaming of car seat cushions)
01. 08. 2019 - 31. 12. 2021	FALCON collaboration - FEM-modeling of external stress on housings of infra-red trackers
01. 05. 2019 - 31. 05. 2024	LIANDRI collaboration - Error estimation of distance measurements
01. 05. 2019 - 31. 08. 2019	P&G Manufacturing GmbH (Schwalbach am Taunus) - ML- and AI-driven mitigation of sensor noise
01. 02. 2018 - 31. 05. 2018	Honda (London) - Mathematical modeling of factory workers' performance
01. 05. 2017 - 31. 01. 2020	Sense Vojta Project at DRK-Kinderklinik (Siegen) - ML-driven frequency analysis of body part movements
01. 03. 2017 - 31. 05. 2024	nexonar Calibration Automation - Automation of the camera calibration process

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Certificates

AC-conference, Rüsselsheim am Main	09.09.2023: »*Github for Data Scientists*« (contribution: test)
AC-conference, Rüsselsheim am Main	31.08.2023: »*SAS Programming Essentials*« (contribution: test)
AC-conference, Rüsselsheim am Main	01.06.2023: »*SAP Business One Basics & SAP Production Planning*« (contribution: test)
AC-conference, Rüsselsheim am Main	30.05.2023: »*Develop your leadership philosophy*« (contribution: test)
AC-conference, Rüsselsheim am Main	07.03.2023: »*Power BI: Dashboards for Beginners*« (contribution: test)
AC-conference, Rüsselsheim am Main	07.01.2023: »*Strategic thinking and action for managers*« (contribution: test)
AC-conference, Rüsselsheim am Main	24.11.2022: »*Talent Framework Atlas Copco Course*« (contribution: test)
Since January 2022	Employed at **nexonar (Atlas Copco GmbH)** in **Rüsselsheim** as **Optical Engineer**
since 01. 08. 2021	14 CCMA[1] research-conferences conducted (Rüsselsheim am Main)
February 19th 2019, Berlin	**VDI-Conference** (contribution: presentation »*Sensor-based diagnostics according to the Vojta principle*«)
Since March 2017	Employed at **Soft2tec GmbH** in **Rüsselsheim** as **Technology Consultant**
November 2016, Atlanta (USA)	**Atomic Physics 2016 Conference** (invited as a speaker, contributions: presentation & poster)
January 2016, Bad Honnef	**605th DPG-seminar** (contribution: poster)
October 2015, Bad Honnef	**600th DPG-seminar** (contribution: poster)
May 2015, Bad Honnef	**586th DPG-seminar** (contribution: poster)
May 2015, Pecs (Ungarn)	**3rd Work Meeting** (contribution: presentation, international collaboration)
March 2015, Heidelberg	**DPG-conference** (contribution: poster)
March 2014, Berlin	**DPG-conference** (contribution: presentation)
May 2013, TU Darmstadt	**Zertifikat Hochschullehre** of the HDA (Hochschuldidaktische Arbeitsstelle)
March 2013, Hannover	**DPG-conference** (contribution: poster)
March 2012, Stuttgart	**DPG-conference** (contribution: poster)
May 2012, Bad Honnef	**500th DPG-seminar** (contribution: poster)
01.10.2008 - 30.09.2010, *TU Darmstadt*	Business, Corporate and Organization Management (M.Sc. lectures)
01.10.2005 - 30.09.2010, *TU Darmstadt*	Internship Measurement technology[2]

[1] nexonar's research division on "**C**amera **C**alibration & **M**easurement **A**ccuracy"
[2] Practical physical courses in measurement technology (divisions: Solid state physics, Polymer physics, Nuclear physics, Astronomy, Optics)

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Scolarships

2005 - 2007	Scolarship of the **Studienstiftung des deutschen Volkes** (reimbursement of expenses for books)
2002 - 2005	Scolarship of the **Gemeinnützigen Hertie-Stiftung** for Grammar school students (reimbursement of expenses for books)

Languages

German	fluent
English	fluent
Russian	elementary knowledge
Serbian	native speaker

Computer knowledge (see also the detailed IT-Skills list below)

Programming languages:	preferred languages: Mathematica, MATLAB, Python, R, C#, GAS advanced knowledge: Octave, Maple, Maxima, Sage, Scilab, Scala, C++ basic knowledge: Java, HTML, PHP, VBA, Perl, SQL, SPSS, SAS, ASP.NET, MongoDB, RUST, Google Cloud, PowerBI, Django, Hibernate/Spring
Platforms:	Windows-Vista, -7, -8, -10, -11, Linux
General applications:	MS-Office (Word, PowerPoint, Excel), Open Office, Gnuplot, Origin, Euler, LyX, LaTeX, LaTexDraw, Gimp, Inkscape, WinFIG, Visual Studio

Articles

Eur. Phys. J. **D 69**, 232 (2015)	Nenad Balanesković »*Random unitary evolution model of quantum Darwinism with pure decoherence*«
Eur. Phys. J. **D 70**, 177 (2016)	Nenad Balanesković, Marc Mendler »*Dissipation, dephasing and quantum Darwinism in qubit systems with random unitary interactions*«

Publications

ISBN 978-3-659-83733-3 Scolar's Press	Nenad Balanesković, »*Random Unitary Operations and Quantum Darwinism - Environment as an efficient quantum memory*«

Hobbies

Chess, Fitness, Literature	Authors: E. A. **Poe**, A. C. **Doyle**, H. G. **Wells**

Miscellaneous

Advanced knowledge:	Artificial Intelligence, SCRUM, Data Mining, Natural Language Processing, Machine Learning, UML, Design Patterns, MLflow

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Overview of IT-Skills

Levels of knowledge and experience

●○○○○ elementary knowledge
●●○○○ elementary knowledge and basic project experience
●●●○○ advanced project experience
●●●●○ deep knowledge
●●●●● expert

Issue	Level	Details	Experience [Years]	Optional : Description of experience
Languages:				
MATLAB / Simulink Wolfram Mathematica	●●●●○	also used: Octave,Sage, Maxima	13	[17]-[14], [12]-[2]
Python, R	●●●●○	Python-Packages: OpenCV, Qt5, SymPy Keras, TensorFlow Control, NumPy Pandas, nltk, PyPI SpaCy, PyTorch	12	[15], [12]-[2]
(Visual) C++, C#/.NET	●●●○○	regular usage	11	[17]-[15], [13], [9], [7]
VBA, GAS, SPSS, SAS	●●○○○	regular usage	6	[17]-[7], [3]-[2]
Java 8, Shell-Scripting, D	●●○○○	see Description	6	[17]-[15], [7]
Perl, Scala, Dart/Flutter	●●○○○	see Description	4	[7]
Go, PHP, HTML, CSS, Rust	●●○○○	see Description	3	[15], [7]
Data bases:				
MySQL	●●○○○	regular usage	3	[15]-[14], [12]-[7]
MongoDB (PyMongo)	●●○○○	regular usage	3	[14], [12]-[7]
Hadoop, PySpark	●●○○○	see Description	3	[7]
Operating systems:				
Windows (8, 10, 11)	●●○○○	regular usage	15	[14]-[3]
Linux	●●○○○	see Description	11	[17]-[15], [7]
Tools:				
Office: MS, Libre, Open	●●●○○	regular usage	13	[17]-[2]
MS Visual Studio (Code)	●●●○○	regular usage	9	[17]-[5]
Anaconda	●●●○○	regular usage	6	[15], [12]-[2]
Eclipse, NetBeans	●●○○○	see Description	4	[17]-[15]
PowerShell	●●○○○	see Description	3	[14], [11]-[5]
Google Cloud, MS Azure	●●○○○	see Description	2	[4]
Miscellaneous:				
SCRUM, Kanban	●●○○○	regular usage	5	[15]-[14], [8]-[1]
GitHub, GitLab	●●○○○	see Description	5	[9]-[5], [2]
Gimp, Inkscape, WinFIG	●●●○○	regular usage	11	[15]-[5]
LyX, LaTeX	●●●●○	regular usage	20	[17]-[14], [12]-[2]
Gnuplot, Origin	●●●●○	regular usage	20	[17]-[5]
UML, Design Patterns	●●○○○	see Description	4	[14], [12], [9]-[7]
LibreCAD, FreeCAD	●●○○○	see Description	2	[7], [5]
Ethereum, Arduino, LabView	●○○○○	see Description	2	[7]

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Levels of knowledge and experience

●○○○○ elementary knowledge
●●○○○ elementary knowledge and basic project experience
●●●○○ advanced project experience
●●●●○ deep knowledge
●●●●● expert

Issue	Level	Details	Experience [Years]	Optional : Description of experience
Frameworks:				
Hibernate Spring	●○○○○	see Description	1	[7]-[2]
Django	●○○○○	with Python-Packages: OpenCV, Qt5, SymPy Keras, TensorFlow Control, NumPy Pandas, nltk, PyPI SpaCy, PyTorch	1	[7]-[2]
Kubernetes	●○○○○	see Description	1	[7]-[2]
Git / Github	●●●○○	see Description	2	[7]-[2]
MLflow	●●○○○	see Description	1	[7]-[2]
Business Analysis Tools:				
PowerBI	●●○○○	see Description	2	[7]-[1]

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Professional Experience

Contents

1 Project 17:

01 2023 - 06 2024 Customer: **nexonar GmbH (Rüsselsheim)**
Different research projects for Desoutter & AtlasCopco
»Design of a new infra-red Tracker Form«

Nexonar's infra-red (IR) trackers are used in numerous customer applications. In order to operate these IR-trackers rely on optimal geometrical placement of IR-diodes along their three rigid body axes.

The aim of this project is to design a new form of IR-trackers whose diode placement along its three rigid body axes guarantees robustness of distance measurements with respect to small tracker tilts.

Tasks:

- Write an article containing a thorough mathematical and physical study of desired (optimal) IR-tracker forms.
- Perform an optimization analysis of diode placements along the three rigid body axes of desired IR-tracker design candidates aided by Python and R.
- Visualization of all results with Python and MATLAB.
- Bug fixing, process documentation.

Technologies:

- MATLAB, R;
- Python;
- Google Apps Script, PowerBI;
- Motion Visualizer, 3DAWin, GML, FlyCapture;
- LaTeX;
- Scrum, Github/Git.

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2 Project 16:

04 2022 - 06 2024 Customer: **soft2tec GmbH (Rüsselsheim)**
Different research projects for Desoutter & AtlasCopco
»PyQt5 Camera Pre-Calibration GUI«

Soft2tec's infra-red (IR) cameras are used in numerous customer applications. In order to operate they use license files generated via nexonar's Camera License Tool from an xml-file containing a list of estimated intrinsic camera parameters. These estimates of intrinsic camera parameters (such as its focal length or its principal axis) are generated by OpenCV calibration algorithms running over a set of chessboard images collected by a robotic agent with respect to a specific IR-camera.

The aim of this project is to design a PythonQt5-GUI which should perform a cumulative error-reprojection analysis of an entire set of collected chessboard images associated with a particular IR-camera and extract from them a subset of »appropriate« chessboard images that would lead to optimal estimates of intrinsic camera parameters prior to the final stage of the OpenCV-calibration.

Tasks:

- Write a PythonQt5 script which should provide a GUI-driven characterization of chessboard images based on cumulative OpenCV-error reprojection prior to their final calibration.
- Perform histogram analysis of chessboard images by means of error reprojections with Python, ImageJ and R in order to acquire experimental estimates of a subset of collected chessboard images that may be ignored when performing OpenCV calibrations.
- Visualization of all results with Python and MATLAB.
- Bug fixing, process documentation.

Technologies:

- MATLAB, Wolfram Mathematica, R;
- Python (Keras, TensorFlow, OpenCV, Qt5, MLflow);
- Google Apps Script;
- Motion Visualizer, 3DAWin, GML, FlyCapture;
- LaTeX, PowerBI;
- ImageJ;
- Scrum.

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3 Project 15:

12 2021 - 03 2022 Customer: **soft2tec GmbH (Rüsselsheim)**
Different MQTT-driven projects (Nissan, BMW, Airbus)
»Automation of Lens Aperture Adjustments«

Soft2tec's infra-red (IR) cameras are used in numerous customer applications. Therefore, an automated adjustment of appropriate lens aperture values would accelerate and enhance the procedure of camera calibration and validation considerably. Therefore, it is, as a first step, necessary to obtain reliable theoretical predictions of confidence intervals for aperture adjustments of lenses characterized by different focal lengths (GAS, MATLAB, R).

In addition, as a further research step, it appears important to acquire experimental estimates of reliable confidence intervals for aperture adjustments associated with different types of lenses (Python, ImageJ, R) .

Finally, one should also compare all findings of the afore mentioned two research steps and thus cross-validate them mutually (MATLAB, Wolfram Mathematica).

Tasks:

- Write a GAS script which should provide reliable theoretical confidence intervals for aperture adjustments associated with lenses characterized by different focal lengths.
- Perform histogram analysis of pixel-brightness on GML-generated bmp files with Python, ImageJ and R in order to acquire experimental estimates of reliable confidence intervals for aperture adjustments associated with lenses characterized by different focal lengths.
- Visualization of all results with Python and MATLAB.
- Bug fixing, process documentation.

Technologies:

- MATLAB, Wolfram Mathematica, R;
- Python (Keras, TensorFlow, OpenCV, MLflow);
- Google Apps Script;
- Motion Visualizer, 3DAWin, GML, FlyCapture;
- LaTeX;
- ImageJ;
- Scrum.

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4 Project 14:

05 2021 - 06 2024 Customer: **soft2tec GmbH (Rüsselsheim)**
»Cloud-based Automation of Camera Validation«

Soft2tec's infra-red (IR) cameras are used in numerous customer applications. Therefore, a stable GAS routine should be designed that would parse csv files of camera-tracker distance measurements captured by Motion Visualizer (MV) and calculate static as well as dynamic projections of error interval width with respect to each individual camera (as specified by its corresponding serial number, SN). This would allow one to classify and validate a camera without being forced to perform manual translation measurements via 3DAWin.

In addition, the functionality of the GAS routine should also be deployed to Google Cloud.

Finally, one should also perform data analysis on xml-files (generated by the GML-software) containing camera parameters and their tolerance intervals and infer whether it is possible to correlate different parameter ranges with specific classification types of the camera validation procedure. If successful, this analysis could even eliminate the necessity of an explicit camera validation by replacing it with an implicit validation approach, in accordance with ISO/IEC 17025.

Tasks:

- Write and deploy a GAS script to Google Cloud that should automatize the camera validation procedure and compute dynamic error tolerances of camera tracker distance measurements based on their static counterparts.
- Perform data mining analysis on GML-generated xml files containing parameters of calibrated cameras and study the possible correlations between calculated tolerance ranges of camera parameters and specific classification types of the camera validation procedure.
- Visualization of all results with Python and MATLAB.
- Bug fixing, process documentation.

Technologies:

- MATLAB, Wolfram Mathematica, R;
- Python (Keras, TensorFlow, OpenCV, MLflow);
- Excel, Google Apps Script, PowerBI;
- Motion Visualizer, 3DAWin, GML;
- LaTeX, GitLab, GitHub;
- Google Cloud, VS Core;
- Scrum, Power-Shell, Kubernetes.

5 Project 13:

08 2019 -12 2021 Customer: **soft2tec GmbH (Rüsselsheim)**
FALCON-project collaboration
»FEM-Modeling of External Stress on Tracker Housings«

Soft2tec's infra-red (IR) trackers are used in numerous customer applications and often have to endure high external forces. Therefore, a thorough FEM-analysis of stress-distribution throughout the entire tracker-housing should lead to valuable insights into robustness of materials currently used in the framework of the tracker manufacturing process.

In addition, the results of an FEM-analysis should be compared with standard predictions of stress distribution within tracker-housings obtained by utilizing a static rigid rod model.

This should also allow to assess whether a full-fledged FEM-modeling should be considered as a necessary analytical approach compared to a simpler (and cheaper) static rigid rod modeling with respect to future robustness tests performed on tracker-housings.

Tasks:

- Perform an FEM-analysis of soft2tec-tracker housings and their robustness when subjected to varying external forces.
- Compare the FEM-results with robustness predictions obtained from a standard static model of tracker-housings composed of rigid rods.
- Visualization of all results with Python.
- Bug fixing, process documentation.

Technologies:

- MATLAB, Wolfram Mathematica, R;
- Python, Keras, TensorFlow, MLflow;
- Excel, Google Apps Script;
- Motion Visualizer, 3DAWin;
- LaTeX;
- FreeCAD, LibreCAD;
- Scrum, Power-Shell.

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6 Project 12:

05 2019 - 06 2024 Customer: **soft2tec GmbH (Rüsselsheim)**
LIANDRI-project collaboration
»Error Estimation of Distance Measurements«

When providing customer-related service it is of highest importance for soft2tec GmbH to supply each customer with infra-red cameras and trackers suitable for their specific projects. Therefore, an interactive GUI, which should provide reliable estimates of camera-tracker distances and their accuracy with respect to different camera parameters as inquiry inputs, would considerably improve the just-in-time support and interaction between soft2tec and its collaborators. Additionally, a thorough algorithmic design of data acquisition, preparation and pattern extraction methods should lead to new experimental setups and Gauge studies, especially with respect to dynamic measurements of camera-tracker distances.

Tasks:

- Design a MATLAB-module within a MATLAB-GUI that should provide maximum estimates of distance errors along the camera's z-axis measured by IR-cameras (rectangular sensor) and NIR-cameras (square sensor) with respect to lenses of different focal length (8 mm, 12.5 mm and 16 mm) and shutter times (0.5 ms, 1 ms, 1.5 ms and 2 ms) for different z-distances between an infra-red camera and an M-size tracker.
- Analyze the z-dependence of tracker's diode-pixels dected by an infra-red camera with respect different pixel-resolutions of camera sensors and lenses of different focal lengths, as well as by taking into account several increasing values of shutter time.
- Design algorithms for data acquisition with respect to enlarged camera's parameter spaces both within static and dynamic measurements of tracker-camera distances along the camera's z-axis.
- Bug fixing, process documentation.

Technologies:

- MATLAB, Wolfram Mathematica, R;
- Python, Keras, TensorFlow, MLflow;
- Motion Visualizer, 3DAWin;
- LaTeX;
- Scrum, Power-Shell.

7 Project 11:

03 2017 - 06 2024 Customer: **soft2tec GmbH (Rüsselsheim)**
»Automation of the camera calibration process«

In order to standardize the camera and tracker calibration processes their main procedural steps need to be fully automated. This will in turn increase the output of calibrated cameras and trackers and ensure the reliability of their distance measurements and movement tracking capabilities. The main goal remains an automatized, robot-driven system capable of calibrating infra-red (IR) cameras and trackers, as well as validating their performance by means of standardized statistical inference methods. This project relies partially on results and experience obtained within earlier completed projects, such as [14], [10], [9], [8], [6] and [5] introduces new research topics outlined within the task list below.

Tasks:

- Design an appropriate camera calibration procedure and conceptualize its robot-driven implementation;
- Analyze the the ideal placement of electrical components within the robot's control cabinet from the point of view of temperature distribution and ventilation - Python (Qt5, Control, LabView, Simulink);
- Maintain regularly the robot's frontend web page (Go, HTML, PHP, Flutter/Dart);
- Parse robot's log files for specific error message types via Python's Natural Language Processing Toolkit (nltk) in order to improve the error response of the robot's frontend from the standpoint of its clarity.
- Store all images of the calibration chess board into a data lake (PySpark, Hadoop, Java, Scala) and maintain a reference data base of all files (xml, licenses, etc) generated during camera and tracker calibration procedures (MySQL, MongoDB);
- Optimize GML's image processing algorithms - Python (OpenCV, Keras, TensorFlow, MLflow);
- Implement MATLAB-routines for statistical inference and time-series analysis that should aid an automatized validation of calibrated cameras and test them with Wolfram Mathematica and C# (MATLAB, Wolfram Mathematica, R, C#, Excel VBA, SPSS, Google Apps Script, SAS);
- Test the Arduino-code implementing robot's movement trajectories (C++) and time-optimize robot's trajectories by setting up the corresponding movement recipes within the robot's frontend (web page);
- Compare the performance of C++ mathematical libraries with their corresponding Rust implementations (Rust);
- Bug fixing, process documentation (FreeCAD, LaTeX).

Technologies:

- MATLAB, Wolfram Mathematica, R;
- Python (Qt5, Control, OpenCV), Keras, TensorFlow ;
- C++, C#, Java, Scala, Rust;
- Excel, Google Apps Script, VBA, SPSS, PowerBI;
- MySQL, MongoDB, SAS, PySpark, Hadoop, Kubernetes;
- LabView, Arduino;
- Motion Visualizer, 3DAWin;
- Go, HTML, PHP, Flutter/Dart;
- LaTeX, Scrum, Power-Shell, GitHub, GitLab.

8 Project 10:

11 2018 - 03 2019 Customer: **Faurecia Germany (Rüsselsheim)**
»Quaternion-analysis of movement patterns for a steaming robot with MATLAB«

In the first instance of this project one aims to characterize relation between the robot's position measurements and the Euler-angle data, which then need to be transformed into the Quaternion picture by means of MATLAB.

Such quaternionic representation of angle-measurement data (robot's orientation) is then fed into robot's software to ensure robot's proper movements during the process of automatized steaming of car seats.

Tasks:

- Design a MATLAB-executable capable of transforming angular movement coordinates into their quaternionic representation a steaming robot-software is capable to understand;
- Bug fixing, process documentation.

Technologies:

- MATLAB, Wolfram Mathematica;
- Python, Keras, TensorFlow;
- Excel, Google Apps Script, VBA, SPSS;
- MySQL, MongoDB;
- Motion Visualizer, 3DAWin;
- LaTeX, Scrum, Power-Shell.

9 Project 9:

08 2018 - 10 2019 Customer: **soft2tec GmbH (Rüsselsheim)**
»Gauge R&R Study Optimization of the Robustness of Distance Measurements in the Course of a Standard Camera Calibration Procedure«

In the first instance of this project one aims to characterize the robustness of distance-errors obtained in the course of camera calibration-related distance measurements between a specific camera and the standard infra-red (IR) calibration-tracker M13.

This task should be accomplished by means of the Gauge R&R Study. The data evaluation algorithms are intended to be implemented as Google Apps Script and MATLAB's OOP-modules that should, in the long run, be part of the overall automatization-process of the standard camera calibration procedure established in the course of numerous (more than 200) calibration experiments (performed within the time-window between 15. 03. 2017 and 30. 04. 2018). These modules should then be translated (ported) into the C# code.

Finally, by looking at the error-robustness of different cameras (with different serial numbers), one could even obtain a tolerance range within which future error-values of camera-tracker distances could be anticipated, thereby enhancing the decision-making process of the (future) automatized camera-calibration procedure(s). This would allow us in the future to offer customer-adapted camera calibration solutions and thus perform a Gauge R&R Study for each customer separately.

Tasks:

- Design a full-fledged GoogleAppsScript macro capable of performing a Gauge R&R study over gathered measurements recorded with soft2tec's Motion Visualizer software;
- Bug fixing, process documentation.

Technologies:

- MATLAB, Wolfram Mathematica;
- C#, C++;
- Python, Keras, TensorFlow, Qt5;
- Excel, Google Apps Script, VBA;
- MySQL, MongoDB, SAS, SPSS;
- Motion Visualizer, 3DAWin;
- LaTeX, Power-Shell.

10 Project 8:

05 2018 - 07 2018 Customer: **soft2tec GmbH (Rüsselsheim)**
»Linear Regression Optimization of the Robustness of Distance Measurements in the Course of the Standard Camera Calibration Procedure«

In the first instance of this project one aims to characterize the robustness of distance-errors obtained in the course of camera calibration-related distance measurements between a specific camera and the standard infra-red (IR) calibration-tracker M13.

This task should be accomplished by means of the machine-learning driven linear (or even non-linear) regression (if necessary). The data evaluation algorithms are intended to be implemented as a MATLAB-module that should, in the long run, be part of the overall automatization-process of the standard camera calibration procedure established in the course of numerous (more than 200) calibration experiments (performed within the time-window between 15. 03. 2017 and 30. 04. 2018).

As a further feature one could also test the distance-error robustness with respect to tracker-codings other than M13, or even with respect to multiple tracker-codings operating simultaneously. This would allow us to extract those coding-combinations (groups) of trackers that operate, from the point of view of the camera calibration, in a mutually compatible manner.

Finally, by looking at the error-robustness of different cameras (with different serial numbers), one could even obtain a tolerance range within which future error-values of camera-tracker distances could be anticipated, thereby enhancing the decision-making process of the (future) automatized camera-calibration procedure(s).

Tasks:

- Analytical and mathematical modeling and description of the robustness of distance measurements generated by the standard soft2tec-calibration procedure by means of standard machine learning techniques;
- Bug fixing, process documentation.

Technologies:

- MATLAB, Wolfram Mathematica;
- C#, C++, R;
- Python, Keras, TensorFlow, Qt5;
- Excel, Octave, MySQL, MongoDB, SAS, SPSS;
- Motion Visualizer, 3DAWin;
- LaTeX, Power-Shell.

11 Project 7:

03 2018 - 05 2018 Customer: **Honda Engineering Europe Ltd (Swindon)**
»Design of mathematical and physical criteria for the evaluation of movement and performance processes at a motor block assembly line«

In order to describe temporal performance (efficiency) of workers when bolting together motor blocks at an assembly line in a mathematically and physically correct manner, that would in turn facilitate a design of a proper feedback software system, *Personal Perfomance Index* (**PPI**) has been introduced and thoroughly tested based on real data measurements performed and gathered in a Honda-plant in Swindon.

Tasks:

- Design of mathematically and physically motivated criteria (quantities) for measuring temporal efficiency of workers at a motor block assembly line;
- Bug fixing, process documentation.

Technologies:

- Analytical modeling (especially functional and fractional calculus);
- MATLAB, Python, Visual C++, Wolfram Mathematica, Rust;
- Excel, MySQL, MongoDB, SPSS;
- LaTeX, Power-Shell.

12 Project 6:

09 2017 - 03 2020 Customer: **ISI Bau- und Gebäudedienstleistungen GmbH (Frankfurt am Main)**
»Extension of the Matlab's data analysis GUI with functionalities for pattern recognition of construction grid movements«

A MATLAB-GUI structure should be designed which would distinguish construction grid undergoing dynamic changes from its state of rest. This could be achieved by exposing a construction grid to diverse contolled external influences (such as shaking, hits, deliberate movements, etc.) and recording its acceleration and angular velocity by means of Internal Measurement Units (IMUs).

Such signals could then be exposed to MATLAB-modules for frequency and time domain analysis already present within the MATLAB-GUI designed in the course of the SenseVojta project in order to enable reliable recognition and prediction of construction grid movements. This type of MATLAB-functionality would then provide essential data analytical services as part of a larger software warning system designed for capturing unexpected (often weather-induced) movements of construction grids.

Tasks:

- Design an appropriate MATLAB-GUI functionality for pattern recognition and prediction of construction grid movements;
- Bug fixing, process documentation.

Technologies:

- MATLAB, Python, Visual C++, Wolfram Mathematica;
- Excel, MySQL, MongoDB;
- LaTeX.

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13 Project 5:

09 2017 - 10 2017 Customer: **Carl-Zeiss SMT GmbH (Roßdorf)**
»Error mitigation in the Auto Global Alignment (AGA) Module«

Extension and repair of the already existing Auto Global Alignment (AGA) module written in C++. The AGA module should correctly recognize edges of all types of masks made from MoSi (molybdenum-silicon) and EUV-materials and yield the correct number of detected mask edges (2, 4 or 6).

Tasks:

- Visual Studio C++ programming of modules responcible for the recognition of edges and structures within mask profiles produced from diverse materials;
- Bug fixing.

Technologies:

- Visual Studio;
- Visual C++, Excel.

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14 Project 4:

04 2017 - 02 2020 Customer: **Internationale Vojta Gesellschaft e. V. (Siegen)**
»Matlab Data Analysis Structure for SenseVojta-Measurements«

Through the therapeutic use of reex locomotion, attributed to Dr. Vaclav Vojta, elementary movement patterns of patients with damaged central nervous system and musculoskeletal system can be restored (at least regarding some body areas), i.e. these movement patterns may become accessible to the patient. Reex movements are activated with the help of the SenseVojta (SV) therapy: during a therapy session, the therapist exerts targeted pressure on certain areas of the patient's body.

A patient usually lies on his stomach, back or side. Pressure stimuli of therapists lead to the activation of spontaneous (unconsciously used) movements of muscles, especially within the spine region, however spontaneous movements of patient's arms, legs, hands and feet - regardless of his/her age - may also occur. Through the use of SV reex locomotion, performing elementary components of human locomotion, such as

1. the balance of patient's body during movements (postural control);
2. maintenance of patient's upright body posture (opposed to the direction of the gravitational force) and
3. targeted gripping and walking movements of the limbs (phasic mobility) become feasible again.

The SenseVojta (SV) project aims at aiding therapists with a software infrastructure that could reliably characterize six possible activity levels1 (0-5) of a particular patient. For details regarding the SV therapy, which we do not intend to address here, please refer to the web site https://www.vojta.com/en/ (subsection The Vojta principle).

More specically, we will implement a MATLAB-GUI for combining machine learning techniques with standard frequency analysis of measured signals that could offer reliable predictions of patient's activity levels during a regular SV therapy session. This MATLAB-GUI should:

- provide a data analysis structure that would quantitatively aid therapists during therapy sessions in their aim to recognize movement patterns of patients;
- execute different scripts (such as spectrogram or psdWelch) suited for time (series) and frequency analysis of measured signals such that many measurement sessions could be compared with each other;
- allow new MATLAB-scripts to be flexibly added and removed from the execution sequence, if necessary;
- allow machine learning supported comparisons of velocity, acceleration and angular velocity measurements in time and frequency domain extracted from signals recorded by means of infra-red (IR) sensors with respect to different body parts of a patient - breast, arms, legs, abdomen, etc.;
- provide a concise csv report of generated statistical results.

Tasks:

- MATLAB GUI programming for frequency and time analysis of movement signals measured by sensors;
- Design of machine learning algorithms;
- Bugfixing, documentation.

Technologies:

- MATLAB, Octave, Java;
- Excel, MySQL, MongoDB, SAS, SPSS;
- Redmine, Jenkins. Motion Visualizer, 3DAWin;
- Scrum, LaTeX, Power-Shell.

15 Project 3:

10 2011 - 03 2016 Customer: **Institut für Angewandte Physik, TU Darmstadt, research group of Prof. Dr. Gernot Alber »Dynamics of Open Quantum Systems and Quantum Computers« – research, education and application development**

Design of modern concepts of quantum mechanical algorithms and their and application in quantum computers. In the course of this research project mathematical and physical criteria for the most efficient data storage of data have been proposed and utilized within the design of an appropriate layered quantum hard disk structure.

Tasks:

- OOP of numerical simulations (quantum networks, stochastic differential equations, graph theory) with C++, C# and MATLAB;
- Code-testing with Wolfram Mathematica, Python, R and MATLAB;
- Process documentation mit LaTeX;
- Development of a GUI for numerical simulations with MATLAB, C# and Visual C++;
- Design, update and maintenance of the Institute's webpage with HTML und PHP.

Technologies:

- Visual Studio;
- C++, MATLAB, R, Python, Wolfram Mathematica;
- HTML, PHP, Java, MySQL;
- Linux/Windows, LaTeX, SPSS, SAS, Shell-Scripting;
- C#, WPF;
- Scrum.

16 Project 2:

11 2009 - 02 2011 Customer: **Institut für Theoretische Kernphysik, TU Darmstadt, research group of Prof. Dr. Jürgen Berges »Functional Renormalization and Non-Equilibrium in the Early Evolution of the Universe« – research, education and application development**

Theoretical description of the inflationary phase in the course of the early evolution of the Universe by means of the functional renormalization group (FRG).

Tasks:

- OOP of numerical simulations (functional renormalization group, partial differential equations) with C++ and MATLAB;
- Code-testing with Wolfram Mathematica and MATLAB;
- Process documentation mit LaTeX;
- Development of a GUI for numerical simulations with MATLAB.

Technologies:

- Visual C++;
- Wolfram Mathematica, MATLAB;
- Linux/Windows, LaTeX, SPSS, SAS, Shell-Scripting.

17 Project 1:

10 2007 - 03 2008 Customer: **Institut für Theoretische Kernphysik, TU Darmstadt, research group of Prof. Dr. Jürgen Berges**
»Non-Equilibrium Initial Conditions for Plasma Instabilities« – research, education and application development

Theoretical description of the universe immediately after its formation („big bang“) along with physical conditions that used to dominate its early evolution by means of modern mathematical and physical concepts of quantum field theory (QFT).

Tasks:

- OOP of numerical simulations (functional renormalization group, partial differential equations) with C++ and C;
- Code-testing with Wolfram Mathematica and MATLAB;
- Process documentation with LaTeX;
- Extension and redesign of an existing C++ console application for numerical simulations.

Technologies:

- Visual C++, Objective C;
- Wolfram Mathematica, MATLAB;
- Linux/Windows, LaTeX, SPSS, SAS, Shell-Scripting.