Curriculum Vitae

Chafic Abu Antoun
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Education

Since 2020 **ETH**zürich	**Diploma of Advanced Studies (DAS in Data Science)** ETHZ_DAS_DataScience **Eidgenössische Technische Hochschule Zürich (ETHZ), Switzerland** Hardware for Machine Learning, Image Analysis and Computer Vision, Neural Information Processing, Statistics, Machine Learning and Artificial Intelligence, Big Data Systems
2012-2017 EPFL ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE	**Ph.D. (Doktor és Science)** @ Integrated Actuators Laboratory (LAI) & @ Robotics, Control, and Intelligent Systems (EDRS) **École polytechnique fédérale de Lausanne (EPFL), Switzerland** Provide an efficient robust model in frequency and time domains, optimized for distinctive detection of metals by electromagnetic induction technology with features like material, shape and size discrimination. Distinctive detection is the main scientific contribution of this work. The challenge against superposition of signals and interferences makes it very difficult for discriminating the above features at low frequency (less than MHz). Machine learning algorithms were applied in regression of physically parametrized time series of electric signals (pulsed and harmonic) induced by magnetic signals. The training and optimization were based on experimental data. Prediction resolution was improved enormously in spite the reduction of complexity. This work has been protected by two patents at the end. Feature selection, feature reduction, nonlinear optimizations, robust predictions, and smart discrimination were all performed with various mathematical tools and algorithms. Validations of many scenarios in tests were self-defined and executed. https://infoscience.epfl.ch/record/230132
2005-2007 Universität Stuttgart	**Master of Science in Computational Mechanics of Materials and Structure** COMMAS **Stuttgart University, Stuttgart, Germany** Master Thesis at Hilti AG, Schaan, Liechtenstein: *"Multidisciplinary Optimization of the Thermodynamic Behaviour of a Gas-Powered Fastening Tool"* *"Funded by Hilti Scholarship"*
2000-2002	**Master of Science in Mechanical Engineering** http://www.balamand.edu.lb **University of Balamand, Koura, Lebanon** Master thesis: *"The Effect of Fiber Waviness on Elastic Behavior of Composite Materials"* *"Student Excellence Award"*
1997-2000	**Bachelor of Science in Mechanical Engineering** http://www.balamand.edu.lb **University of Balamand, Koura, Lebanon** Bachelor thesis: *"New effective design of airfoil wing"* *"Three times on the Dean's honor list"*
1984-1997	**Scientific Baccalaureates** www.bhs.edu.lb **Brummana High School, Brummana, Lebanon** *"Graduation with honors"*

Work Experience

since 07/2007 HILTI	**Research engineer** **Corporate Research & Technology, Hilti AG, Schaan, Liechtenstein** Research topics: o **_optimization of electromagnetic eddy current system_** Global optimization using particle swarm and genetic algorithms for constrained multi-objective optimization. (MATLAB, self-written scripts) o **_machine learning: supervised, unsupervised, reinforced._** Machine learning methods for optimization purposes of multi-field drives. The training of data (simulation and experimental) lead to fast accurate models that can be used for optimization purposes or active control. Deep learning is used for time series regression. Artificial Intelligence of drives is implemented on few applications as well. (Python, MATLAB, WEKA) o **_batteries_** Lithium batteries activities from research to experimental validations of single cells to fully industrialized batteries. The work also involved a virtual multi-field model on the cell and pack level to be used in the testing and development teams. The model is successfully validated. (ANSYS, MATLAB) o **_drives R&D_** Integrated in the research and development team of battery driven machines. The work involved a creation of an accurate virtual tool for an eddy current system. It is successfully validated and being used as a reference in drive development. The research involved coupling of many physical fields with an integration of global optimization model subjected to equality and non-equality constraint. (ANSYS, MATLAB, python) o **_motors and actuators_** Creation and implementation of a transient electromagnetic Finite Element Method preserving eddy currents and changing reluctance. The model is validated with functional demonstrator. (ANSYS, MATLAB, python) o **_induction heating, induction hardening, underground detection_** Creation and implementation of a transient finite element model. It is experimentally validated (voltage and current measurements) for medium frequency electromagnetic fields coupled to heat transfer with a two-way coupling. o **_motors and actuators_** Quasi-static electromagnetic simulation of linear motor concepts (ANSYS, Simulink). Simplified mode for fast comparison of concepts o **_motors and actuators_** Improvement of motor cooling using Computational Fluid Dynamics with conjugate heat transfer (ANSYS CFX) Miscellaneous Tasks: o **High performance computing** (HPC), migration and implementation of commercial software from a single node UNIX server to a Linux cluster. Supporting the optimization of parallel computing o **CFD** simulation of different blade shapes of a mixer of two fluids (ANSYS CFX) o **Explicit dynamics** simulation of impact mechanisms (LSDYNA)
2019-2022 HILTI	**Project leader (technical)** **Corporate Research & Technology, Hilti AG, Schaan, Liechtenstein** o Researching and proposing new technology concepts. Validate them experimentally for a family of Hilti products. If it is proven mature enough, then it can outperform state of the art concepts.

2006-2007	**Master thesis**
	Corporate Research & Technology, Hilti AG, Schaan, Liechtenstein
	Optimizing thermodynamic processes and structure in a fastening machine (ANSYS, ANSYS CFX, ANSYS ICEMCFD, MATLAB)
2003-2007	**Project engineer**
	Roland Ruegenberg GmbH, Bad Sobernheim, Germany and Teetronic GmbH, Bretzenheim, Germany
	Projects:
	o Design optimization of floating horn mechanism (ANSYS). Production of aluminum parts milled by CNC. Implementation of prototype in Mercedes, VW, "Pioniergeist 2005" award → news
	o Optimization of capacitive based torque sensor by reducing the number of input signals and linearizing the output (MATLAB). Electrostatic simulations were performed for validation (ANSYS)
	o Design of steering wheel switches for Ford Mondeo respecting the moldability of the parts and the tolerance stack of the whole assembly. Optimizing the light pipe design by simulation
	o Feasibility study of a position sensor based on permanent magnet and Hall sensors (ANSYS)
2003	**Project engineer**
	Methode Electronics International, Gau-Algesheim, Germany
	Design of plastic parts for mechatronic automotive switches (CATIA V5)
09/2002	**Training**
	Institut Universitaire de Technologie, Cachan, France
	Design and manufacturing of mechanical parts (CATIA V5R7 & CNC machine) scholarship granted by the French government
09/2000	**Practical Training**
	Trans Mediterranean Airlines (TMA), Beirut, Lebanon.
	Maintenance and control on pneumatic system, hydraulic system, jet engine and landing gear

Software

CAD/CAM	CATIA V5 R16 (+++), UG NX9 (++), Visual Mill 5 (+), Surfcam 2004 (+), MoldFlow Plastic Insight 4.1 (+)	
FEA	ANSYS 2019R3 (+++), LS-Dyna971 (+), Msc Nastran 4.5 (++), ANSYS ICEMCFD 2019R3 (+++),	(+++): excellent
CFD	ANSYS CFX 19.0 (++)	
EMAG	ANSYS EMAG 2019R3 (+++), ANSYS MAXWELL 2019R3 (++)	
Dynamics	MSC Visual Nastran 4D 2003 (+++), Mechanical Dynamics Adams 11 (+)	(++): good
Electronics	Orcad 10.0 (+), Protel DXP (+), Altium Designer 14 (++)	
Project	Microsoft Project (++), Jira (++), Agile processes (++)	
Mathematical Optimization & Machine Learn.	WEKA (+), python (+++), MATLAB (+++), (statistics & Machine Learning, Neural Network, Probabilistic AI) Pandas, Matplotlib, Seaborn, NumPy, SciPy (+++), Scikit-Learn (+++), TensorFlow (++), Anacoda (+++), Docker (+), (Continuous Integration & serverless environments)	(+): basic

Languages

English	German	French	Arabic
Excellent	Good	Basic	Mother tongue

Awards and rewards

Lean Award 2019	Hilti Group	Schaan, Liechtenstein	13.03.2020
COMMAS scholarship 2006	Hilti AG	Schaan, Liechtenstein	01.11.2006
PIONIERGEIST award 2005	ISB	RL-P, Germany	07.06.2005
French government Scholarship	Institut Universitaire de Technologie	Cachan, France	01.09.2002
Student excellence award	University of Balamand	Al-Koura, Lebanon	06.07.2002

Interests

Skiing, mountain biking, Inline skating, tennis, 3D designs, psychology

Patents

01	EP3361290A1 , WO2018146124A1 ,	Detection Method for a Scanning Detector
02	EP3217193A1 , WO2017153213A1 ,	Scanning Detector and Control Method
03	EP2674252B1 , US20130333904A1 ,	Machine tool and control method
04	US20130336809A1	Fastener-driving device and controlling method
05	US9259830B2	Striking mechanism and hand-held power tool
06	EP2063518B1 , US20090127940A1 ,	Linear Motor
07	EP2676773B1	Setting device and control method
08	EP3578312A1 , US20210220981A1 ,	Capacitor
09	EP3578313A1 , US20210197351A1 ,	High energy motor learned feature variations by Machine Learning
10	EP3578316A1 , US20210237244A1 ,	Actuator best electric definitions
11	EP3578314A1 , WO2019233844A1 ,	Device cooling methods
12	EP3578307A1 , US20210187715A1 ,	Capacitor orientation
13	EP3578308A1 , WO2019233844A1 ,	Setting device - performance controller
14	EP3760381A1 , WO2021001196A1 ,	Working tool - various smart ferromagnetic stators
15	WO2021122351A1 , EP3838495A1 , US20230018142A1	Stacked brushed actuator smart design
16	WO2021122313A1 , EP3838490A1 , US20230001555A1	Stacked brushed linear motor
17	WO2021122294A1 , EP3838492A1 , US20230011145A1	Transverse efficient slim motor
18	WO2021122270A1 , EP3838493A1 , US20230012189A1	Multistage coil gun highest energy density
19	WO2021122325A1 , EP3838491A1 , US20230008745A1	Linear brushed smart connection
20	WO2021122230A1 , EP3838494A1 , US20230007855A1	Freewheeling diode invention on actuator
21	WO2021122228A1 , EP3838496A1 ,	Single stage multi coil gun accelerator with flux addition
22	WO2022128330A1 , EP4011537A1 ,	Diamond positioning method and apparatus using electrostatics
23	WO2023217610A1 , EP4275855A1 ,	Method for producing a drill segment, drill segment, and drill bit

In addition to the published patents above, there are currently **four** pending claimed patent applications which are undisclosed prior to the publication date.

Papers and Journals

International Conference on Agents and Artificial Intelligence (ICAART), SciTePress	Feb. 2021	Vienna, Austria	*Sensorless Coil Temperature Measurements using Neural Networks for Voltage Control* *Science and Technology Publications* *International Conference on Agents and Artificial Intelligence*
IEEE Magnetics Letters, vol.8, no.1,pp.0-5	Feb. 2017	*Journal*	*Balanced Metal Detector Based on Optimized Frequencies and Spatial Phase Profile Responses to Differentiate Metal Rods* https://ieeexplore.ieee.org/document/7864323
Advances In Magnetics	Mar. 2016	Bormio, Italy	*Smart self-calibrated metal detector, simulated, designed, verified, and used to discriminate single and multiple materials* http://aim2016.tr.unipg.it/
Int. Conf. on Electromagnetics in Advanced App. (ICEAA), pp.1171-1174, 7-11	Sep. 2015	Turin, Italy	*Frequency Analysis of Finite Steel Cylinders and their Comparison to Complex Cylinder-like Targets using an Electromagnetic Induction Sensor* *IEEE xplore*
IEEE Transactions on Magnetics, vol.51, no.3, pp.1,4	Mar. 2015	*Journal*	*Validity Tests of Superposition Principle Based on Forward Model for Electromagnetic Induction Scattering* *IEEE xplore*
Journal of International Conference on Electrical Machines and Systems, Vol. 3 #3	Sep. 2014	*Journal*	*Robust and Efficient 3D Model of an Electromagnetic Induction (EMI) Sensor* https://doi.org/10.11142/jicems.2014.3.3.325
Conference on Electromagnetic Field Computation, (CEFC)	May 2014	Annecy, France	*Validity Tests of Superposition Principle Based on Forward Model for Electromagnetic Induction Scattering* http://cefc2014.org//
International Conference on Electrical Machines and Systems,	Oct. 2013	Busan, S. Korea	*Robust and Efficient 3D Model of an Electromagnetic Induction (EMI) Sensor* *IEEE xplore*
Proceedings of the American Society for Composites 17th Tech. Conf., ASC	2002	Lafayette, IN, USA	*The Effect of Fiber Waviness on Elastic Behavior of Composite Materials* http://www.asc-composites.org/proceedings-toc/2002/cont2002.pdf
Proceedings of the American Society for Composites 16th Tech. Conf., ASC	2001	Blacksburg, VA, USA	*Micromechanical Formulation of Multilayered Composites in Thermo elasticity* http://www.asc-composites.org/proceedings-toc/2001/cont2001.pdf

Workshop & training

CAD & Pre/Post processing			
o CATIA V5R10 Basics	TansCAT GmbH & Co.	Karlsruhe, DE	28.03.2003
o Automatisierung, Skripten, & Post Processing für CFD & System simulation	CADFEM (ANSYS)	Stuttgart, DE	21.10.2011
o Fortgeschrittene Vernetzungsmethoden mit ANSYS meshing	CADFEM (ANSYS)	Grafing, DE	10.07.2012
o Tipps und Tricks zur Vernetzung	CADFEM (ANSYS)	Grafing, DE	11.07.2012
o Praktische Werkstoff Simulation mit JMatPro	MATPLUS (JMatPro)	Wuppertal, DE	17.10.2018
Explicit dynamics			
o Einführung in LSDYNA	DYNAMORE (LSDYNA)	Ingolstadt, DE	17.09.2008
Electromagnetics & Multi-field			
o Berechnung elektrischer Antriebe mit ANSYS Workbench	CADFEM (ANSYS)	Grafing, DE	26.02.2008
o Induction Simulation with ANSYS	CADFEM (ANSYS)	Grafing, DE	17.07.2008
Batteries			
o Batteries, Fuel Cells, & EV	Wyon AG (Shmuel De-Leon Energy Ltd)	Appenzell, CH	25.11.2016
o Modellierung von Batterien und Brennstoffzellen	COMSOL (COMSOL Multiphysics)	Berlin, DE	02.03.2017
Machine Learning and AI			
o Applied Machine Learning Days	EPFL	Lausanne, CH	30.01.2019
Project management			
o Mastering Project Management	Hilti L&D (Hilti AG)	Schaan, LI	05.07.2019

References

Prof. Yves Perriard	EPFL STI IMT LAI, MC A4 298 (Microcity) Rue de la Maladière 71b, CP 526, CH-2002 Neuchâtel 2, Switzerland +41 216954310	EPFL, École Polytechnique Fédérale de Lausanne	http://people.epfl.ch/yves.perriard?lang=en
Prof. Christoph Würsch	Institut für Computational Engineering ICE Werdenbergstrasse 4, CH-9471 Buchs, Switzerland +41 81755 3452	OST, Ostschweizer Fachhochschule	https://www.ost.ch/de/person/person/christoph-wuersch-1255/
Roland Ruegenberg	Igelsbachstraße 8, D-55566, Bad Sobernheim, Germany +49 6751853532	Roland Ruegenberg GmbH	www.r-find-r.de