TOPICALITIES

Edited by Markéta Držková

CONTENTS

News & more

Recently completed projects funded under Horizon 2020

Besides the selected projects that are introduced in more detail in the following sections, the Horizon 2020 projects funded till past months include, for example, SILENSE, developing (ultra)sound interfaces and low energy integrated sensors by combining conventional silicon technologies with printed flexible, large-area electronics, HoliFAB (Holistic digital-to-physical prototyping and production pilot for microfluidic MEMS), SmartLine (Smart inline metrology and control for boosting the yield and quality of high-volume manufacturing of organic electronics), iPES-3DBat (Innovative polymeric batteries by 3D printing), FLUID (Functional low-intensity light upconverting inks for everyday applications), and several bioprinting projects. The projects supporting business innovation, which started in 2018 and have been completed in recent months, include FoodiniPro (The connected 3D food printer appliance for every kitchen), HelpingHAND (A 3D printed, affordable myoelectrical prosthetic hand of personalizeable size for optimal comfort and functionality), and TUMOURPRINT (High throughput bioprinting of tumour models for drug development and oncology research).

GrapheneCore2 – Graphene Flagship Core Project 2

This project with a budget of 88 mil. EUR represents the third stage of the EC-funded part of the Graphene Flagship, which is coordinated from Sweeden by the Chalmers University of Technology. More than 150 partners are taking part in the core project, and the number of associated members, mostly industrial, has grown over 90. Almost nine hundred peer-reviewed articles published within GrapheneCore2 include an extensive open-access review of 2D materials named 'Production and processing of graphene and related materials', with 70 co-authors and over 1 500 references. Among other outcomes, there are dozens of reports on various technological aspects of graphene and related materials, models for pH and ionic strength graphene charge-neutrality point and for current–voltage characteristics for graphene solution-gated field-effect transistors implemented in MathWorks MATLAB, multianalyte sensing demonstrator, nano-oscillator prototype, textile demonstrator, demonstrators of anti-corrosion coatings and photocatalytic coatings for air or water remediation in real-life conditions and building materials, and the graphene-perovskite solar park in Crete.

In October 2020, the project 2D-EPL – Graphene Flagship 2D Experimental Pilot Line was launched to enable prototype production of electronics, photonics and sensors based on graphene and related layered materials.

INNPAPER – Innovative and smart printed electronics based on multifunctionalized paper: from smart labelling to point of care bioplatforms

This long-term project being completed this June has been coordinated by the CIDETEC organisation based in Spain. Contributing to the research and innovations towards paper-based electronics, the project involved the design and manufacturing of the platform integrating battery, display and a near-field communication system printed on a multifunctional paper sheet

New Intergraf publications

Intergraf, the European federation for print and digital communication, has recently released its regular annual reports and also five guidance documents to help printers and other related companies comply with the new legislation and implement the necessary measures.

The 2021 Intergraf Economic Report summarises the available statistical data for the graphic industry in the European Union, United Kingdom, Norway and Switzerland. The first part briefly overviews the current global and European economic situation, provides information on the European graphic industry in terms of its profile, labour costs, production value and trade figures, and reviews the development in print markets and 12 selected countries. Namely, it includes the reports from Belgium, Bulgaria, Denmark, Germany, Italy, Latvia, Lithuania, Luxembourg, The Netherlands, Norway, Portugal, and Sweden. The second part consists of the European print market review for 2020–2025 provided by Smithers and the post-Brexit UK print market review provided by the British Printing Industries Federation.

The documents reflecting recent changes to legislative requirements and best practices relevant to the graphic arts industry include the Guide to the EU Ecolabel for Printed Paper, covering a new set of criteria focusing on the main environmental impacts throughout the lifecycle of the printed paper products that was adopted in November 2020, the Guide to the Authorisation of Chromium Trioxide Use for Gravure Printers, granted by the European Commission in December 2020, the Guide to the EU-UK Trade and Cooperation Agreement, which provides information about the main provisions for trade between EU and UK companies, such as customs, VAT

and the rules of origin requirements, the document named BAT in Heatset: Practical and Legal Guidance, dealing with the best available techniques conclusions as established in the Commission Implementing Decision (EU) 2020/2009 under Directive 2010/75/EU on industrial emissions, which are applicable to heatset plants, and the Guide to Applying Food Contact Materials Legislation, prepared in cooperation with the Flexographic Technical Association Europe. The first three guidance documents published since last December are only available for Intergraf members, while the last two can be downloaded from the Intergraf website, including the Solvent Mass Balance/Solvent Management Plan Template in Excel sheet.

A complete overview of the work carried out during the past year and the future outlook can be found in the Intergraf Activity Report for the period from June 2020 to May 2021.

The winners of the TAGA student awards

This time, the Technical Association of the Graphic Arts invited the students from the schools worldwide to submit their work to competitions. While the winners of the student poster and student research journal competitions are yet to be announced, the winners of the individual awards for 2021 are already known. Based on the scores for relevance, technical content, clarity, discussion, bibliography, and charts/graphs/illustrations, Samantha Stante from Ryerson University (Toronto, Canada) has won the Harvey Levenson Undergraduate Student Paper Award for her paper 'What Impact do the Accessibility Features of Colour and Contrast, Text-to-Speech, and Magnification in ePublications Have on Undergraduate Students' Ability to Retain Information?', and Maayane Lugassy from Grenoble INP Pagora (Grenoble, France) has won the Dusty Rhodes Graduate Student Paper Award for her paper 'Study of the Behavior of Cadmium-Free Quantum Dots in Functional Inks'.

by screen-printing to be used in three use-cases. These comprise smart labels for food packaging that include humidity, temperature and pressure sensors, point-of-care quantitative immunoassays for drug and caffeine detection in saliva and drinks, respectively, and point-of-care genetic assays for rapid diagnosis of infectious diseases (influenza virus and Streptococcus bacteria). Collection, display and cloud storage of the data can be accomplished using a free smartphone application.

NanoTextSurf – Nanotextured surfaces for membranes, protective textiles, friction pads and abrasive materials

This three-year project coordinated by VTT, Technical Research Center of Finland, and completed in November 2020 aimed to upgrade the existing pilot lines for manufacturing and demonstrating nanotextured surfaces with mechanically enhanced properties through the application of cellulose nanomaterials by cast coating, foam coating and screen-printing. Among the studied products, the development of barrier coating based on microfibrillated cellulose and two novel abrasive materials using cellulose nanocrystals as additives and applied on textile and plastic substrates, respectively, continues in three industrial-scale implementation projects.

SeSaMe – Sustainable routes for smart photonic materials

This long-term project started in 2015 and finished this March received the European Research Council Starting Grant and was hosted by The Chancellor, Masters and Scholars of the University of Cambridge. The interdisciplinary research studied the assembly and optical response of natural materials, cellulose and chitin, to allow the production of low-cost, biodegradable photonic materials. The findings were published in almost 40 scientific articles, two book chapters and a doctoral thesis. The outcomes include the successful fabrication of cellulose-only coloured particles that can be used as bio-compatible and edible pigments.

NANOGEN – Polymer-based piezoelectric nanogenerators for energy harvesting

This is another project hosted by The Chancellor, Masters and Scholars of the University of Cambridge and funded by the European Research Council Starting Grant. It was focused on nanoscale piezoelectric energy harvesters based on ferroelectric polymers. During five years from 2015 to 2020, the researchers identified suitable piezoelectric polymers and incorporated them into scalable nanogenerator devices through the use of novel additive manufacturing routes. See also the doctoral thesis 'Aerosol-jet printed nanocomposites for flexible and stretchable thermoelectric generators' presented in the previous issue of JPMTR.

Photomechanics – Photomechanical printing in Europe in the mid-19th century: History, theory, visual culture, science and the international network in the 1840s–1860s

This project coordinated by De Montfort University (UK) illustrates that not all resources are directed towards innovations. One of the outcomes of the research supported through a one-year individual fellowship grant till September 2020 is an open-access online database with visual and textual data about preserved incunabula and other relevant visual and written documents identified in dozens of collections. Some early experiments to reproduce daguerreotypes are introduced by an online exhibition.

Bookshelf

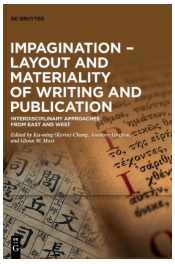
Impagination – Layout and Materiality of Writing and Publication
Interdisciplinary Approaches from East and West

This work deals with the placing of text and other content onto a carrier medium, investigating the type of page or another corresponding unit, its written or printed content, and the way the content elements, including graphics, are spatially arranged. That all the authors express by the title word, impagination. The book considers various aspects of local conventions and traditions of impagination, bringing a global comparison of the relations between materials and formats as well as between formats and layouts. It pays attention to the extent of paratextual information and discusses the importance of psychological aspects, social practices, textual genres and other influences for adaptation of existing approaches or invention of the new solutions.

After the introduction, the book includes 13 chapters written by the editors and other 10 authors. The five chapters of the first part describe the impagination before and up to the paged codex format. Namely, the authors examine ancient Greek and Roman layouts from the early ones on papyrus rolls to the late ones on parchment in codices, the development of the form and layout of the Hebrew Bible, early Chinese texts from those on bamboo slips to paper editions, the evolution of the page layout of Tibetan Kanjurs based on the analysis of different loose-leaf editions of the Tibetan Vimalakīrtinirdeśa dating from before 1035 to 1934, and the impagination practices in South Asia, in particular, in the early Hindi manuscripts from the 14th through early 17th centuries.

The second main part, named The Printed World, examines reader's drawings on the margins of early printed pages in Renaissance Europe, Samganghaengsildo, the Korean book on ethics, particularly its version from 1505 with three narratives (two textual, in Chinese and Korean scripts, and one pictorial) and their mutual interaction on the printed page, the evolution of the typical page in the hand-press era till the beginning of the industrial revolution in the Southern Netherlands, the specific layout of some woodblock-printed books in early modern China, two typical layouts for different layers of Chinese texts, i.e. the pages with two or three horizontal sections and the pages with two columns of small characters inserted into the primary text, the ambilingual design in Chinese/Manchu language reference manuals, and the changes in the layout of pages with transformations in media in Japan.

The last part comprises only one chapter that investigates the latest practice of scientific publication, which is going online, beyond the physical page. Today, scientists commonly access periodical publications in digital format on the internet. This shift is connected with various advantages, including the earlier access to the articles prior to their hard-copy publication, instant updates of publication metrics, and multimedia content taking the visual supplements to a new level.



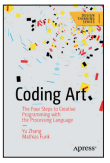
Editors: Ku-ming (Kevin) Chang, Anthony Grafton, Glenn W. Most

Publisher: De Gruyter
1st ed., January 2021
ISBN: 978-3-11-069846-6
428 pages, 83 images
Hardcover
Available also as an eBook

Coding Art
The Four Steps to Creative Programming with the Processing Language

Authors: Yu Zhang, Mathias Funk

Publisher: Apress
1st ed., January 2021
ISBN: 978-1484262634
296 pages, 33 images
Softcover
Also as an eBook



This book published in the Design Thinking series is aimed at artists and designers rather than computer scientists. The first part explains the basics of creative coding – the types and properties of visual elements, canvas transformations, animation and the interactive input, composition and structure, as well as the more advanced options, such as working with noise or using functions, up to the artwork completion, testing and deployment. The second part presents the practical example. The last part is focused on coding practice and advises how to deal with problems, gain advanced skills and improve the creative processes.

Programming Media Art Using Processing
A Beginner's Guide

Author: Margaret Noble

Publisher: CRC Press
1st ed., December 2020
ISBN: 978-0367509590
248 pages, 278 images
Hardcover
Also as an eBook

This is another book that introduces visual design using the Processing language. Each of its eight chapters provides the series of lessons with step-by-step examples, starting with the basic overview and then showing how to create responsive environments, automated animations and animated collages, employ conditional interactions and rollovers, develop simple games and work with multilevel architectures and arrays. The project examples are available from the publisher's website.

Principles of Image Printing Technology

Principles of Image Printing Technology written by Yuri Kuznetsov provide a comprehensive overview of the challenges of prepress in the graphic arts industry. The book allows the reader to enter the problematics from a historical point of view up to the current state-of-the-art solutions used in graphic arts. The selected topics are described in-depth both in terms of technical fundamentals and industrial procedures. While some problematics the author explains more in detail, the others are described only superficially. The book is structured into 14 chapters, which cover topics such as image processing, halftoning and related screening techniques, basics of colorimetry, colour management, colour reproduction, basics of optics, film and plate image setters principles, image capturing and sampling, image processing, etc. The book includes quite a large number of images and illustrations, which is helpful for the understanding of the content. On the other hand, it is obvious that the book suffers from insufficient editorial care – not appropriate sorting of the chapters is present, and some information/problematics are spread too much within the whole publication instead of being collected to one chapter. A flaw in the beauty of the book is given by the low quality of some images; some are even distorted, which is not appropriate for such type of publication. The overall high educational value of the book is complemented by the short tests included after every chapter, which are beneficial for the evaluation of the understanding of learned problematics. Overall, the book is for students and readers interested in graphic arts, especially in terms of prepress and related fundaments.

Book review by Tomáš Syrový, University of Pardubice

Author: Yuri V. Kuznetsov

Publisher: Springer
1st ed., February 2021
ISBN: 978-3-030-60954-2
382 pages, 207 images
Hardcover
Available also as an eBook

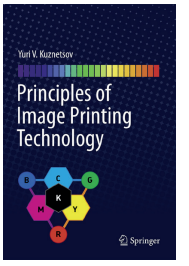
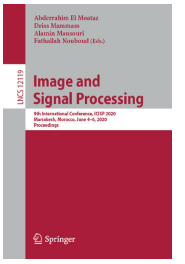


Image and Signal Processing

This volume presents 40 papers selected from submissions to the 9th International Conference on Image and Signal Processing, ICISP 2020, which was cancelled due to COVID-19. The topics include, among others, extraction and recognition of Bangla texts from natural scene images using convolutional neural networks, logo detection using fuzzy clustering algorithm and texture features, and image watermarking based on Fourier-Mellin transform.

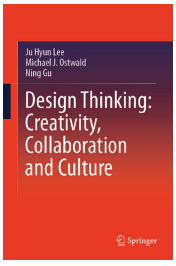
Editors: Abderrahim El Moataz, Driss Mammass, Alamin Mansouri, Fathallah Nouboud

Publisher: Springer
1st ed., July 2020
ISBN: 978-3-030-51934-6
400 pages, 179 images
Softcover
Available also as an eBook



Design Thinking
Creativity, Collaboration and Culture

The authors of this book explore the design process supported by digital design environments and provide insight into various strategies of design thinking, which is seen as critical for facing the complex challenges of the present world successfully. The introduction defines the concept of design thinking and presents the research methods employed to gain an understanding of the cognitive operations that occur in design thinking, namely the protocol analysis and expert panel assessment. Three parts then deal in detail with design thinking in terms of creativity, collaboration and culture, as summarised in the fourth, concluding part.

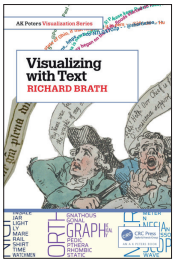


Authors: Ju Hyun Lee, Michael J. Ostwald, Ning Gu

Publisher: Springer
1st ed., August 2020
ISBN: 978-3-030-56557-2
263 pages, 40 images
Hardcover
Available also as an eBook

Visualizing with Text

In this book from the AK Peters Visualization Series, the author builds on the relevant research and literature sources as well as on his long experience in data visualisation and visual analytics. The book presents the text as an integral part of visualisation, beyond the simple support of graphical representation. The content is organised into four parts. The first one documents why to visualise with text, providing the examples from cartography, typography, tables, science classification and notation, code editors, alphanumeric charts, art and poetry, graphic design and advertising, comics, postmodern text, and also from data visualisation, such as knowledge maps or real-time visualisations. It also defines the design space of visualisation with text and overviews the attributes that can be used. The second part presents the use of text for point labels, in stem-and-leaf distribution plots and as the microtext lines, for example, in the line charts with many series. The third part deals with the applications of text formatting to better discriminate multiple sets and categories, convey information in maps and ordered data visualisations, or visualise ratios and quantitative data. Finally, the last part demonstrates how to treat text layouts to enhance reading, facilitate skimming, help with correct pronunciation, spelling and prosody, use the so-called spark words to encode different kinds of data, and more. The book is illustrated with both historical and present examples from various fields, with more material available on the author website.

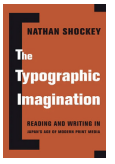


Author: Richard Brath

Publisher: CRC Press
1st ed., November 2020
ISBN: 978-0-367-25930-3
298 pages, 146 images
Hardcover
Available also as an eBook

The Typographic Imagination
Reading and Writing in Japan's Age of Modern Print Media

Author: Nathan Shockey



Publisher: Columbia University Press
1st ed., December 2019
ISBN: 978-0231194280
336 pages, Hardcover
Also as an eBook

This study draws on extensive archival research mapping the commercial print revolution in Japan around the turn of the 19th century into the 20th and through the first decades of the latter when print media, cheap and available, have become a natural part of everyday life. The work examines diverse forms of print and their uses, documents the emergence of new forms of reading, writing and thinking and discusses the related transformation of media and social discourse in modern Japan.

Graphic Design Rules
365 Essential Design Dos and Don'ts

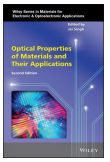
Authors: Sean Adams, Peter Dawson, John Foster, Tony Seddon

Publisher: Princeton Architectural Press
2nd ed., April 2020
ISBN: 978-1616898762
384 pages
Softcover

This guide provides practical tips for working with type and typography, layout and design, colour, images and graphics, production and print, and design practice. Each advice is defined on one page and accompanied with the explanatory text as well as the illustration that helps to get the point quickly. This collection might be helpful for both beginners and practitioners – while some of the rules are present in virtually every book on graphic design, some are far less obvious. The revised edition presents the rules in a clear and neat style, abandoning the "thou shall" tone of the original edition, which had discouraged some readers.

Optical Properties of Materials and Their Applications

Editor: Jai Singh



Publisher: Wiley
2nd ed., January 2020
ISBN: 978-1119506317
672 pages
Hardcover
Also as an eBook

This comprehensive book overviews the fundamental optical properties of materials in general and then the optical properties of disordered condensed matter and glasses. Further, it explains the concept of excitons and photoluminescence and presents the photoinduced changes in noncrystalline semiconductors and chalcogenide glasses. Next, it deals with photonic crystals and glasses, organic semiconductors, thin films, excitonic processes in quantum wells, and diluted magnetic semiconductor nanostructures. The current edition includes the advances since the original one in 2006 and adds new chapters on transparent white organic light-emitting diodes, quantum dots, perovskites, and characterisation by spectroscopic ellipsometry. Also, it discusses the kinetics of the persistent photoconductivity in crystalline III–V semiconductors.

Biomaterials- and Microfluidics-Based Tissue Engineered 3D Models

Editors: J. Miguel Oliveira, Rui L. Reis

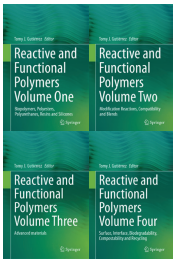
Publisher: Springer
1st ed., April 2020
ISBN: 978-3030365875
182 pages, 42 images
Hardcover
Also as an eBook

In 10 chapters, this book covers the microfluidic devices and 3D printing strategies for in vitro models of bone, processing of biomaterials, organs-on-a-chip, patient-on-a-chip models and liver models, and presents the use of microfluidic systems in studies on the central nervous system, angiogenesis and cancer, as well as for drug discovery and testing.

Reactive and Functional Polymers
Volume One: Biopolymers, Polyesters, Polyurethanes, Resins and Silicones
Volume Two: Modification Reactions, Compatibility and Blends
Volume Three: Advanced materials
Volume Four: Surface, Interface, Biodegradability, Compostability and Recycling

These four volumes published last year cover a wide range of types and applications of reactive and functional polymers together with their reactions, properties and processing. Among others, the topics include biodegradable and functional synthetic polymers in nanomedicine, reactive modification of fibre polymer materials for textile applications, lignin as a natural antioxidant and as a coating and curing agent, and functional biobased composite polymers for food packaging applications in Volume One, compatibilisation and crosslinking of polymer blends, functional hydrogels, grafting of polymers, and reinforced polymers for electroactive devices in Volume Two, active packaging films based on polyolefins modified by nanoparticles, smart and shape-memory polymers, circularly polarised luminescent polymers as emerging materials for photophysical applications, and polymers for dental applications processed by 3D printing in Volume Three, and surface functionalisation of polymers, polymer interface reactions, switchable and supramolecular polymers for bio-interface applications, recycling of reactive and functional polymers, and the parameters influencing the degradation of reactive polymer-based materials in Volume Four.

Editor: Tomy J. Gutiérrez

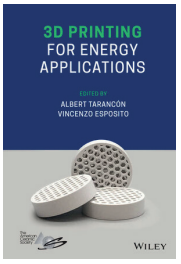


Publisher: Springer
1st ed., August & October 2020
ISBN: 978-3-030-43402-1 & 978-3-030-45134-9
& 978-3-030-50456-4 & 978-3-030-52051-9
438 & 372 & 217 & 261 pages, 170 & 155 & 135 & 110 images
Hardcover
Available also as an eBook

3D Printing for Energy Applications

The first part of this new book presents 3D printing of functional materials, namely metals, ceramics and polymer composites with strain-sensing and self-heating capabilities. The second one discusses the challenges for 3D printing of complex objects, dealing with computational design, multicomponent and multimaterial printing, tailoring component properties and new production concepts. The third part reviews 3D printing of different energy devices, including capacitors, solar cells, fuel cells, electrolysers, turbomachinery components, thermoelectrics, and possible use for carbon capture.

Editors: Albert Tarancón, Vincenzo Esposito



Publisher: Wiley
1st ed., April 2021
ISBN: 978-1-119-56075-3
400 pages
Hardcover
Available also as an eBook

Bookshelf

Academic dissertations

Electromechanical Modelling and Control of Ionic Electroactive Polymer Actuators

Doctoral thesis – Summary

Author:
S. Sunjai Nakshatharan

Speciality field:
Physical Engineering

Supervisors:
Alvo Aabloo
Barbar Akle

Defended:
26 August 2019, University of Tartu, Faculty of Science and Technology, Institute of Technology Tartu, Estonia

Contact:
sunjainakshatharan@gmail.com

This thesis contributes to the research of ionic electroactive polymer materials that can be applied in sensors or actuators. In particular, it addresses their dynamic behaviour by developing an enhanced electromechanical model helping to understand the charge storage kinetics and to predict the bending displacement. It also explores the more straightforward method for the fabrication of soft manipulators and proposes the control techniques for their real-time application. The main content of the dissertation is organised into five chapters. The first of them provides an overview and classification of ionic electroactive polymer actuators and explains the actuation mechanism in the case of carbon–polymer composite and poly(3,4-ethylenedioxythiophene) poly(styrene-sulfonate), PEDOT:PSS. The next one deals with the electro-chemo-mechanical model using the finite element method, which considers the ion transport process, the influence of electrode porosity, the electrochemical kinetics, namely the capacitance of the electric double layer, as well as the redox process for actuators based on conducting polymers, the conditions for charge and material balance, and the mechanical response. This chapter also includes the experimental verification of the electrochemical and electromechanical simulation for actuators from both types of materials. Two chapters then present the development, fabrication and characterisation of a novel soft parallel manipulator utilising four actuators to move the platform with three degrees of freedom. First, the designed manipulator was manually fabricated with the carbon-based electrodes made using spray coating. Then, the manipulator with the PEDOT:PSS electrodes was printed using the syringe-type extrusion system. The performance of both manipulators is compared on the basis of the analysis of their response. Finally, for the printed manipulator, the open-loop application as a four-way optical switch and the closed-loop application as a microscope stage are demonstrated.

Further reading:
ISBN 978-9949-03-117-7

Compact Modeling and Physical Design Automation of Inkjet-Printed Electronics Technology

Doctoral thesis – Summary

Author:
Farhan Rasheed

Speciality field:
Technology Development and Electronic Design Automation

Supervisors:
Mehdi Baradaran Tahoori
Jasmin Aghassi-Hagmann

Defended:
1 July 2020, Karlsruhe Institute of Technology, Department of Informatics Karlsruhe, Germany

Contact:
frasheed.f@gmail.com

Considering the lack of specific design tools and the resulting gap between technology development and circuit design in the area of printed electronics, the concern of this thesis was to provide the models and tools for the standard design flow and electronic design automation to foster the development of inkjet-printed electronics technology, with a particular focus on the electrolyte-gated transistors with inorganic channel material.

The dissertation provides the background on printed electronics, sources of variability in inkjet-printed electronics, especially the coffee-ring effect, drop coalescence and nozzle issues, the electrolyte-gated transistor technology and the fabrication process employed. Also, it discusses the current design flow challenges. Modelling and physical design are identified as the key design flow components, thus being the focus of the work. The contributions include the models to design and verify the circuits in simulation, technology libraries with the substrate information, standard cell constraints and the layout rules, standard and parameterised cell libraries, as well as

the optimisation of cell placement and routing. All these components are combined into the Process Design Kit helping to design, simulate, verify and extract the layout of inkjet-printed circuits. The proposed single-segmented model for printed electrolyte-gated transistors is the extension of the Enz–Krummenacher–Vittoz transistor model and considers all operating regions of output and transfer curves. The work also describes the extraction of model parameters from the data measured for the printed transistors and the estimation of their distribution using a Gaussian Mixture Model. The proposed DC model was experimentally validated for circuit-level simulation, showing higher accuracy when compared with the state-of-the-art models. The developed method of cell placement and routing optimisation employs the evolutionary algorithm and the genetic algorithm, respectively, taking into account the possible issues due to the crossovers insulating the intersections of routing paths in complex inkjet-printed circuits. With this approach, the timing failure paths were significantly reduced through the optimal placement of crossovers. The resulting Process Design Kit for inkjet-printed electronics technology is compatible with the industrial standard computer-aided design and electronic design automation tools.

Further reading:
DOI: 10.5445/IR/1000121285

Doctoral thesis – Summary

Author:
Chikwesiri Tolu Imediegwu

Speciality field:
Engineering

Supervisors:
Robert Hewson
Matthew Santer

Degree conferral:
1 July 2020, Imperial College London, Faculty of Engineering, Department of Aeronautics
London, United Kingdom

Contact:
chikwesiri.imediegwu14@imperial.ac.uk

Multiscale Structural, Thermal and Thermo-Structural Optimization Towards Three-Dimensional Printable Structures

The research in this thesis deals with the optimisation of metamaterials to achieve heterogeneous, spatially varying material properties in the domain of a structure tailored to fulfil functional objectives, with the capacity for their realisation by additive manufacturing. The approach based on the free material optimisation framework employs multiple geometry-based small-scale design parameters for optimisation problems in 3D real space.

The work reviews the methods and approaches used for structural optimisation, namely for the monoscale and multiscale topology optimisation, optimisation of metamaterials and coupled sequential multiscale optimisation. Then, four chapters present the sequential multiscale framework. The development of a microscale model comprises microscale parameterisation, element-based material assignment and homogenisation, which is based on periodic boundary conditions, strain deformation and thermal analyses, and volume averaging. The numerical implementation for a specific microscale model is presented, with the validation of the effective property evaluations, mesh convergence studies, and characterisation of the stress and heat flow. The next step is the generation of the material model, which includes the axis transformation operations, unit cell geometry and material property transformation, property space population and exploration; the performance of lattice parameterisation was checked against Hashin–Shtrikman bounds, with subsequent generation of the response surface model. The last chapter of this part deals with the macroscale problem, presenting the assumptions and mathematical formulations for structural, thermal and thermo-structural optimisation, as well as their numerical implementation with mesh and function space generation, domain initialisation and evaluations. Finally, three chapters describe the systematical application of the framework to seven optimisation problems – namely to compliance minimisation of the top-loaded cantilever beam, engine bracket and goose-neck hinge, structural optimisation considering target deformation for two- and three-prong grippers, thermal optimisation of the cylindrical heat sink, and thermo-structural optimisation of the hollow-pipe section. The proposed approach helped achieve improved optimality of the resulting designs that are physically realisable by additive manufacturing techniques.

Further reading:
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Events

SPIE Optics & Photonics 2021

SPIE. OPTICS+ PHOTONICS San Diego, California, USA & https://spie.org
1–5 August 2021

This year's edition of the event can be joined in person in its traditional venue in North America or participated remotely. It includes three symposia following the advances in Optical Engineering & Applications, Nanoscience & Engineering, and Organic Photonics & Electronics, respectively, featuring altogether more than 50 conferences with over 500 talks to be presented on-site and over 1500 pre-recorded presentations available on demand. For example, the former include the paper describing printing and in-situ investigation of perovskite thin films for printable solar cells and the one demonstrating the approach for accelerating hybrid perovskite research through the use of robotic automation, while the papers dealing with the computer-vision-aided colour correction method for printing content on multiple print media, concepts for inkjet-printed semi-transparent perovskite solar cells for building-integrated photovoltaics, and voxel optimisation in 3D laser nanoprinting to achieve near 100 nm feature sizes can be found among the latter. Also, some speakers chose the option to deliver their lecture remotely to the audience present on site, such as in the case of plenary talks on Coulomb interactions in organic semiconductors and non-radiative voltage losses in organic solar cells. The attendees can also register for the free exhibition on 3–5 August.

SIGGRAPH 2021
The 48th International Conference & Exhibition on Computer Graphics & Interactive Techniques

https://s2021.siggraph.org
9–13 August 2021

SIGGRAPH 2021 This established event organised by ACM SIGGRAPH, a special interest group of the Association for Computing Machinery, is held virtually again in 2021. Besides the live events and sessions scheduled throughout the week, the attendees can access the on-demand content from 2 August to 29 October. Scholarly work in computer graphics technology and interactive techniques is presented at the conference during the technical sessions covering a wide range of topics, such as sketching, colour adjustment for graphic designs, face and character animation, character control, and model optimisation for 3D printing, to name a few. All papers submitted to the ACM Student Research Competition are presented in the poster sessions and then the selected ones during the dedicated session.

In addition, the 20th annual Symposium on Computer Animation (SCA 2021) is held in partnership with Eurographics, the European Association for Computer Graphics. While originally planned to take place in Riverside, California, USA from 30 July to 1 August prior to SIGGRAPH 2021, now it is announced as an entirely online event later in summer, 6–9 September 2021.

NANOTEXNOLOGY 2021

Thessaloniki, Greece
& https://www.nanotexnology.com
3–10 July 2021

nano texnology As in 2020, this event combines both on-site and virtual presentations and participation. Keeping the proven concept, it comprises the symposium on flexible organic electronics, conferences on nanosciences and nanotechnologies, 3D printing and bioprinting, digital and additive manufacturing, related summer schools and exposition, business forum and matchmaking event.

AIC 2021
14th Congress of the International Color Association

https://www.aic2021.org
30 August to 3 September 2021

AIC MILAN 2021 14th AIC Congress This quadrennial multidisciplinary event organised since 1969, and in 2021 for the first time hosted in Italy, is held as an online event due to the ongoing restrictions imposed by the pandemic. It offers five days full of colour-related topics from various fields, including textile design methods for printing with electroluminescent inks, plant transfer printing on cotton and silk, colour gamuts generated by digital printing devices under different conditions, and effects of oxygen on black dye-based inkjet inks fastness.

Online Print Symposium 2021

ONLINE PRINT SYMPOSIUM 2021 Munich, Germany
14–15 September 2021

This year the symposium has the theme 'Start Up and Print Online!' and highlights the start-up potentials, mass customisation, e-commerce and digital transformation.

London Imaging Meeting 2021

http://www.imaging.org
20–22 September 2021

The second edition of this event organised jointly by the Society for Imaging Sciences and Technology and the Institute of Physics is held online again, with the theme 'Imaging for Deep Learning'. One of the announced topics is 'Image understanding for color constancy and vice versa' discussed by Simone Bianco in his focal talk.

ERA Annual Conference and the Packaging & Decorative Conference 2021

Thessaloniki, Greece
21–23 September 2021

The focus of the presentations scheduled for this year's conference of the European Rotogravure Association is clearly expressed by its title: 'Gravure – the Sustainable Print Process'.

Current information and more events to be found on the Internet

The calendar of events is still provisional, as the pandemic waves come and go and return again. While some events are having luck with venues and dates, some must be postponed or transformed in the online format, or both, such as the 11th International Conference on Flexible and Printed Electronics, at first postponed from 2020 to this year and, in the end, ICFPE 2021 is held online anyway (28 September to 1 October, https://www.eng.niigata-u.ac.jp/~icfpe). Some events even had to be cancelled for the second year in a row, such as the fairs Unique 4+1 in Leipzig, Germany, The Print Show in Birmingham, UK, and all events of the Labelexpo Global Series. On the other hand, Tarsus has announced a new event, Label Congress 2021, to take place in Rosemont, Chicago, USA (29 September to 1 October).

Droplets 2021

https://www.sfb1194.tu-darmstadt.de/droplets21
16–18 August 2021

The 5th International Conference on Droplets is held online. The programme offers plenary lectures dealing with hydrodynamic quantum analogues, drag reduction and boundary slip at lubricant-infused surfaces, and drop-based energy harvesting. Topics of over 10 keynote lectures include the electrokinetic transport in a sub-nanometric droplet, nanoscale modelling and computing heat flow for evolving films and drops, direct numerical simulation of drop dynamics, an industry perspective on contact angle measurement, and more.

2nd International Circular Packaging Conference

Slovenj Gradec, Slovenia & https://www.ftpo.eu/CircularPackaging
9–10 September 2021

This hybrid event features three keynote speakers – Francesca Stevens presenting 'EU policy and regulatory developments on packaging', Duncan Mayes exploring 'Renewable materials and the circular economy – opportunities and challenges', and Samir Kopačič discussing 'Functional barrier coating of packaging materials: application of biopolymers and effects on barrier performance'. Further, the programme offers professional and scientific presentations, including a session on smart and sustainable packaging and printing, and a hands-on workshop.

47th iarigai and 52nd International Circle Conferences

Athens, Greece
19–23 September 2021

This year, the iarigai conference entitled 'Printing in the Digital Era' and the conference of the International Circle of Educational Institutes for Graphic Arts Technology and Management (IC) entitled 'Print Education – Challenges in an Uncharted World', are jointly organised by HELGRAMED, the Hellenic Union of Graphic Arts and Media Technology Engineers in cooperation with GRAPHMEDLAB, the Hellenic Graphic-Media Research Lab, University of West Attica. The keynotes confirmed so far are 'Defending the competitiveness of the European graphic industry' by Alison Grace, 'Industry 4.0 in printing & converting – The Bobst vision to shape the future of packaging' by François Martin, and 'After the pandemic: printing becomes more sustainable' by Axel Fischer for the iarigai conference, and 'The connected converter' by Konstantinos Spyropoulos, 'From pixel to drop: inkjet innovations for the digital printing industry' by Stelios Manousakis, and 'During the meta pandemic era: learning continues using simulation technology in print education' by Enn Kerner for both conferences. The scientific papers of the iarigai conference deal with the development of Egyptian Blue pigment for screen printing, water-based conductive inks with carbon black and reduced graphene oxide, a fast fabrication workflow for paper embossing tools, the effect of halftoning on the appearance of 3D printed surfaces, wearable art utilising functional inks and electronics, and other topics.