Mathematician meets Fashion designer

Citation for published version (APA):
Toeters, M. J., & Feijs, L. M. G. (2016). Mathematician meets Fashion designer: The future of fashion will be multidisciplinary innovation! In Empowering the intangible: exploring, feeling and expressing through the arts: book of abstracts (pp. 45)

Document license:
Unspecified

Document status and date:
Published: 01/01/2016

Document Version:
Accepted manuscript including changes made at the peer-review stage

Please check the document version of this publication:
- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher’s website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

Link to publication

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the “Taverne” license above, please follow below link for the End User Agreement:
www.tue.nl/taverne

Take down policy
If you believe that this document breaches copyright please contact us at:
openaccess@tue.nl
providing details and we will investigate your claim.

Download date: 25. Apr. 2019
Mathematician meets Fashion designer:  
The future of fashion will be multidisciplinary innovation!

Marina Toeters, by-wire.net, Utrecht, marina@by-wire.net  
Loe Feijs, Department of Industrial Design, Eindhoven University of Technology, l.m.g.feijs@tue.nl

Abstract. The fashion system recycles the same ideas over and over again, with a very low rate of innovation. We found each other at the cutting edge of fashion innovation and claim that much, much more innovation is possible. We found it is time to analyse our collaborative work and put it in the global context of fashion innovation. The projects are summarised in the paper. In each project we contribute new concepts from fashion, from technology and from mathematics.

Mathematics and fashion. It is essential that we come from complementary disciplines: math, fashion. Ligenza / De Comité is a similar combination. As an example of a cooperation leading to beautiful results, we mention the work of hat designer Gabriela Ligenza (Ligenza 2015) who cooperates with mathematician De Comité (De Comité 2014). The 3D printed hats, based on the mathematical shape called cardioid, are futuristic and express simplicity and complexity at the same time.

New pattern aesthetics. For mathematicians these are exciting times. As Francesco De Comité (De Comité, 2014) writes “innovative programmable machines (laser cutters, 3D printers) allow the dreams of mathematicians to become real: imagine objects, build their representation, manipulate them.”

Fig. 1: 2012: First collaborative project of Loe and Marina: Drapely- O-Lightment (Leonardo 2015)
Regarding the question of beauty, Francesco De Comité (De Comité, 2014) writes: “It is often difficult to define what beauty or aesthetics is. In the light of this example (the cardioidal variations), an answer might be that the underlying simplicity of the definition, together with the complexity of the generated universe of shapes, could be an important part of what makes artistic appeal. Occam’s razor principle and Kolmogorov complexity might be called to the rescue.” This is also what we tried in the pied-de-poule (PDP) and fractal warp knit projects. See here our examples of new pattern aesthetics by the use of mathematical principles, computer processing and digital fabrication tools.

Promising shape-changing interfaces. The topic of shape-changing interfaces is promising (Coelho, Zigelbaum, 2011), but there is a gap between what current technology can offer and what it takes to make it practical, comfortable and affordable. Examples of shape changing garments and the use of and feedback loops are represented in figure 5-13.
The topic of dynamics in garments is also addressed in the work of Mohamad Baharom (Baharom 2016) show in figure 16: a robotic zipper. The European project GHOST (Kwak et al. 2014) studies an area called “soft robotics”, see for example http://softroboticstoolkit.com/.

In dynamic fashion, our hero is Hussein Chalayan. He recently gave new form to the notion of transformation (again) in his SS16 Paris Fashion Week Pasatiempo collection with garments dissolving in water and then revealing a layer of 3D printed garments underneath. Chalayan often collaborates with Moritz Waldemeyer, who pushes the limits of technology.

As we have different backgrounds (fashion & mathematics) we have common ground too. Which is the love for technology. We work in the Eindhoven University of Technology with people like Tomico, Wensveen, Nachtigall, Van Dongen et al. We like hands-on prototyping work and networked organisation approach as the by-wire.net company does. The cooperation is rewarding in itself because of the inspiration and the opening-up of possibilities. The results are distributed via teaching, small design or fashion venues for example (Coleman 2012, Ritsumei 2013, De Kantfabriek 2014, by-wire.net 2015), math/art conferences (Feijs and Toeters 2013, Feijs, Toeters, Hu and Liu 2014, Toeters and Feijs 2014, Feijs and Toeters Bridges 2015, Feijs and Toeters 2016, and an art/techno journal (Feijs and Toeters Leonardo 2015).

**Combining the two principles.** In our latest example we are heading towards combining new pattern aesthetics and shape changing interfaces or dynamics in garments.

The Pied de Pulse project (figure 15) has two aims. The first is to study and implement a fractal-like structure of circles inspired by Apollonian circles, combined with a pied de poule (houndstooth). The second aim is to push the integration of electric actuators in garments, using the power of algorithmic design and digital manufacturing. Digital embroidery-machine patterns in Tajima file format are generated by an extension of Jun Hu’s turtle graphics library Oogway. Flat coils of copper with magnets work as vibration actuators in the garment like the well-known rotary vibration motors, but better integrated in the garment and matching fashion production methods. (Bridges 2016)

**Different time-to-market perspectives.** Combining principles like fractals, Apollonian circles and electronica actuation makes the project a more interesting research topic, but introduces a new complexities as well. Different results have the potential of being practical, but on different timelines; the pied de poules (figure 1-4) are feasible now. During the symposium we can show some examples in an exhibition setting. The dynamic projects (figure 5-13) might enter the market perhaps in ten years and aren’t too easy to reproduce. During the symposium we can show promising concept videos.
Education. We think that the teaching of new possibilities to design students is a good investment for a better and more creative system later. Work of our students Leonie and Mohamad show this.
Our results did not reach “the fashion system” yet), which is no surprise in view of the nature of the fashion system. Fashion is all about making desirable predictions. Timing, context and cultural heritage are key topics to find the right tone of voice, tone of shapes, tone of colours, tone of materials, tone of dynamics and tone of prints. By doing all these collaborative projects we developed a toolbox via which we can react surprisingly quick on special requests by the use of mathematical principles and come close to the desirable tones. Our students extrapolate these skills further.

**Why tech fashion and mathematics is the perfect match.** An established (fashion) brand identity as starting point of a design process can be developed in a new aesthetics when we start playing with Voronoi diagrams, fractals, wallpaper theory and another mathematical tools. Math has a long history. Combining these two principles highly value cultural heritage issues. This is important for the social acceptance of ‘newness’. As wearable technology and shape changing garments are still very unfamiliar for the big audience but highly relevant, we need to play with established methodology to let innovative garments find the way to the market. Via this paper, educational activities and all the collaborative design projects we hope to contribute to this delicate process of innovating the fashion system towards a batter and more creative one.
About the authors:

Loe Feijs has a M.Sc. in electrical engineering and a Ph.D. in computer science. In the 1980s he worked on video compression and telephony systems. He joined Philips Research to develop formal methods for software development. In 1994 he became part-time professor of Mathematics and Computer Science, in 1998 scientific director of the Eindhoven Embedded Systems Institute, and in 2000 vice dean of the new department of Industrial Design at TU/e, Eindhoven. At present he is professor for Industrial Design of Embedded Systems. Feijs is the author of three books on formal methods and of over 100 scientific papers.

Marina Toeters is educated as a fashion designer and holds a Master of Arts. She operates on the cutting edge of technology and fashion design. Through her business by-wire.net she stimulates hands-on collaboration between the fashion industry and technicians for a relevant fashion system and supportive garments for everyday use. She advises, amongst others, Philips Research and the European Space Agency on product development. As a teacher, coach and researcher, she works for the fashion department in the Utrecht school of Arts, textiles in Saxion University for applied science and the Eindhoven University of Technology.

references:


nazcapaca-fashion-technology/

173 DOI 10.1007/s00779-010-0311-y

Coleman, M. curator (2012). Pretty Smart Textiles, Exhibition at Textiles Innovation Centre TIO3 in

Architecture, Culture, 349–352.


de Poule (Houndstooth) Proceedings of Bridges 2016: Mathematics, Music, Art, Architecture, Culture
(in press).

De Kantfabriek (2014). Exposition Tradition Meets Future, Retrieved on December 5, 2015 from the
website http://www.museumdekantfabriek.nl/nieuwe-expositie-traditie-ontmoet-toekomst-is-geopend/

York, NY, USA, 181-190.

