TEXTILE ENQUIRY AND DESIGN

aeolia

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figure 1, left: knitted stretch sensor sample with steel yarn
figure 2, right: three backs with integrated stretch sensor

BACKGROUND

In this essay we introduce the Aeolia project, driving technical textiles research at Nottingham Trent University and involving specialists from a range of disciplines. We will reflect on the roles and experiences of people as they worked within and across their usual boundaries of practice. In particular, the key aspects of risk, unfamiliarity, and criteria for success will be discussed.

The project emerged from a strategic investment by the University in a number of interdisciplinary fellowships, in this case across Product Design and Textiles. The aim of the work has been to examine design methodologies for the development of smart and technical textiles, and to demonstrate the value of textile knowledge to these fields.

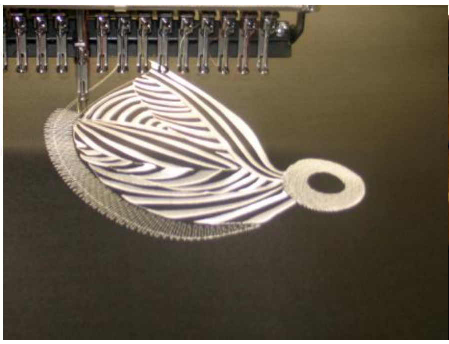


figure 3: multihead embroidery exploration; figure 4: woven 3D sensor trial

To facilitate this, a novel 'smart' fibre was identified as a starting point for textiles exploration. The Merlin stretch sensor (Merlin 2010) was identified as being commercially available but under researched, offering potential for contribution to the field. This carbonised rubber cord, 2mm in diameter, changes its electrical properties when stretched, meaning it may be used in conjunction with a circuit to drive outputs such as light, sound or movement. Figure 4 shows the rubber cord being woven to create an experimental 3D sensor.

CREATION & DESIGN

The aim of the project was to bring a textile methodology to bear on the stretch sensor fibre through the interrogation of strategies for embedding it in weave, knit and embroidery fabrics. Limits to the material's functionality were quickly discovered and have been reported elsewhere (Breedon et a 2008, Glazzard & Kettley 2009), but more importantly we wanted to establish an approach to testing aesthetic potential, and in the process learn more about what constitutes *textile* knowledge.

We know that craft can often take the form of a concurrent, processual form of knowledge: Kinor Jiang describes the influence of Junichi Arai in this respect, in his description of his role as 'textile creator' and not 'textile designer' (2010), differentiating between situated action and planning.

figure 5: visiting researcher Danielle Wilde talks with the team

Initially, there were six collaborators involved in the project, drawn from weave, knit, embroidery, fit, print, product design and interaction design (details given at end). Within this group, individuals took on roles as specialists in their own field of practice (weave, knit, embroidery and fit), or acted as facilitators of practice, guiding the conceptual direction of the project, and acting to frame and contextualise it in different ways. These facilitating roles came to be concerned with the management of unfamiliarity and risk being experienced by the specialists as assumptions about the general disciplines of art and technology were challenged, and differences in design philosophy emerged between the sub genres of textiles (Kettley & Downes 2010). Further introductions to the subject areas were provided by Danielle Wilde, a visiting research fellow in wearable systems and technical textiles in 2009 (figure 5). Note also the importance of physical objects in these meetings; textile samples mingle with electronic hardware and 'soft' electronic demonstrators (switches).

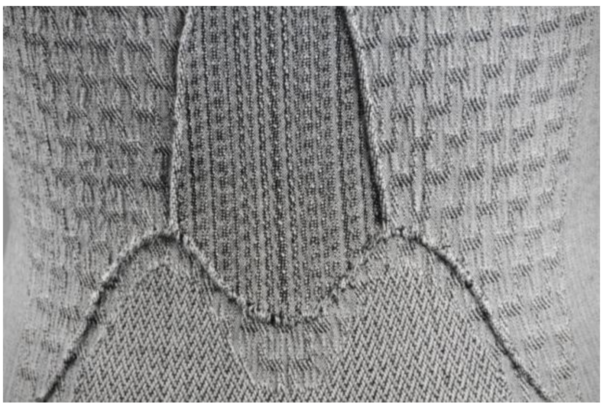


figure 6: detail of woven back with integrated carbonised rubber stretch sensor

We took an experimental approach to the project, unconcerned with final outcomes, objects, needs or applications. In this way we understood it to be a textile led enquiry, focused on such parameters as texture, scale, handle, weight, tactile qualities and colour, and using these as the criteria for success in the application of the new fibre to existing textile specialisms. This is familiar to the textile community, but is challenging to dominant definitions of 'design', which seeks to measure its outcomes in terms of fitness for purpose, with clearly defined user or consumer profiles leading to effectively targeted and often beneficial products. One of the issues identified for wearable technology systems and 'smart' textiles has been that of crossing disciplinary boundaries to create products that take both approaches seriously, and so avoid being relegated as mere gadgetry (Chang 2005, Berzowska 2005, White 2010).

A further problem increasingly identified by creative communities, however, is the difficulty of obtaining samples of new materials, let alone enough of them to facilitate play and the particular kinds of knowledge and learning it in turn generates (Arrow Consulting 2008). By selecting a commercially available fibre, we were able to ensure a large enough supply to explicitly encourage the sort of exploration and risk taking referred to by Jiang and Arai.

Craft has often been written about in terms of risk: David Pye for example articulated the accumulation of value that is at risk in the hand carving of a wooden bowl, as with each cut the potential for damage to considered action increases (1968). Individuals within this team encountered risk in a different way: used to actively exploiting risk for expressive development within their areas of textile expertise, each was now being asked to manage unfamiliar risks, which could not be anticipated. A profound unfamiliarity with concepts found in, for example, the domains of interaction design, wearable computing and electronics, meant that the opportunities and constraints of the stretch sensor as a material for textile enquiry were entirely hidden. Indeed, because the only known aspect of the fibre was that it could '*do* something', exploration was implicitly challenged as a methodology, and it took time for individuals to relax enough to begin the process of serious play. Figure 6 shows a detail of the back woven by Nigel Marshall: together with fitting expert Karen Harrigan, it took many attempts on the Jacquard loom to achieve the correct level of fabric resistance to weave the back in one piece, using varied stitch patterns and controlled areas of tension.

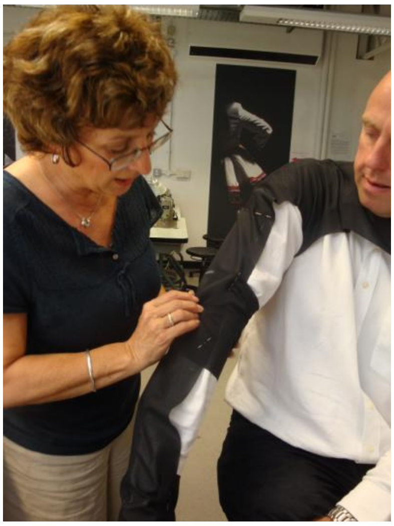
Figure 3 shows an embroidery exploration informed by the broad potential for three dimensional embroidery to house electronic components, and drawn from a shared visual resource, the musculature of the male back. Working together from this source, the fitter and textile artists were able to generate a new joint creative process, which at once provided the space needed for open exploration and the constraints of a garment form fitted to the male body (Kettley & Downes 2010). Three 'backs' were made integrating the rubber stretch sensor in channels constructed as integral design elements in embroidery, knit and weave fabrics (figure 2). These have become, according to our criteria, successful outcomes of the project, exhibiting the potentially rich visual and tactile language of physical computing and wearable technology as informed by embodied textile knowledge. We believe firmly that this could only have been achieved through the deliberate exploitation of textile enquiry as a risky materials-driven methodology not led by functionality driven scenarios. The team intend to continue this strand of the work through examining the pieces worn for example by dancers, introducing movement to guide approaches to output (light or sound changes), and ultimately to inform decisions regarding functionality.

In this way, a textile approach is demonstrated as being quite radical: product design may start with a well defined user 'need' and therefore a broad understanding of function before the process of design begins; interaction design typically considers the experience of the output first (whether by 'users' or 'audience'), and fits the technology to this aim (Igoe 2004). Both of these design strategies reveal an underlying determinism, which we believe embodied processual textile knowledge subverts and complements. However, as the following section describes, our preferred way of working is in turn challenged by designing to a functional brief.

NEW COMPLEXITIES

After the first few months, during which a number of samples had been created and findings disseminated (Breedon et al 2009), the team was presented with an opportunity to design for a specific purpose. New Media Scotland, which had supported the project through its Alt-w program, was to celebrate its tenth anniversary with a showcase of projects, including a cellist working with an electronic sound artist to perform his own commissioned pieces (Alt-w 2009). Could we create an interactive garment for him, incorporating the stretch sensor we had been working with?

Suddenly, difficulties with lack of purpose were removed, and the decision was made to work with our own knitted sensors in preference to the unsatisfactory carbonised rubber fibre (see figure 1). However, new complexities and risks emerged as we sought to design for this new context.



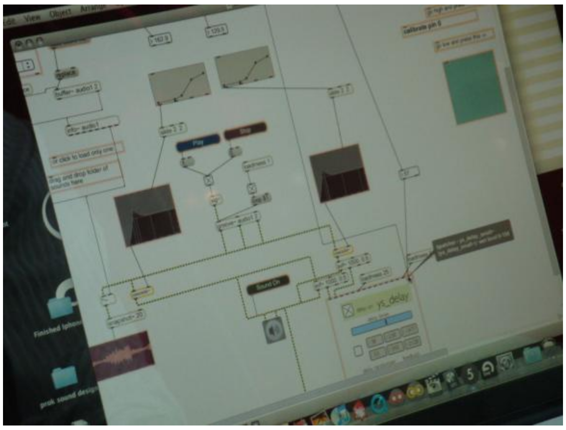


figure 7, left: early fitting of cello garment; figure 8, right: sound design interface

These issues included the relationship of the formal properties of the knitted sensors to their electronic performance, their optimal placement on the body for movement (figure 7), and the nature of the sound output resulting from that gestural data.

We found that richly expressive samples, in which shell like formations emerged from the integral twist of the steel yarn or through ribbing with shirring elastic, often did not give the electronic behaviour we needed. For the moment, the need to favour functionality over expression led us to select simpler forms. Even so, it was apparent that parameters such as width and surface area were in a direct relationship with electronic characteristics, and also with the way people felt compelled to handle them. For example, the broad knitted sensor used at the elbow of the garment is less consistent in its output values than the narrow strip at the underarm. It is also more likely to be 'played' like a concertina if picked up as a sample, while the strip is literally more linear in its interactions and outputs. It is easy to see the potential for textile exploration here, with the relationship between form, function and interaction laid so bare, and we feel it opens up many areas for aesthetically considered design with conductive yarns and fabrics.

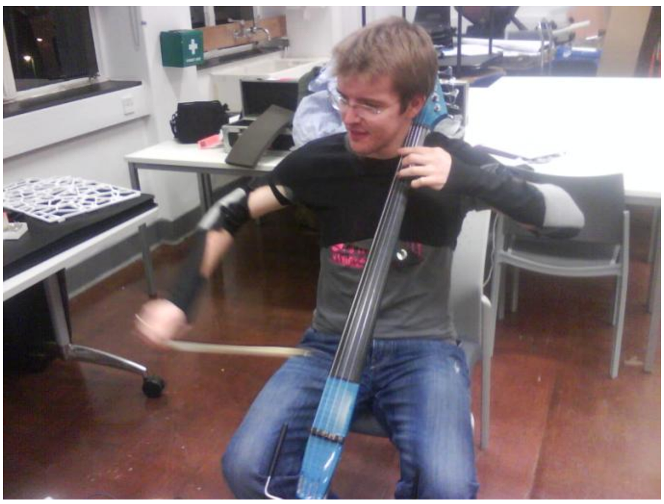


Figure 9: the garment in rehearsal

While we had been asked to make a fitted garment for the cellist, he was not available for fittings before the event, and we had to work to measurements. Watching a video of him in performance, however, we were further tested by the realisation that we were not cutting only for a static body shape, but for that body shape in a gestural relationship with the instrument and the music it was producing (in rehearsal, figure 9). The placement of the sensors had to be considered now along with the mechanical issues of anchor points and the relative stretch of other fabrics involved so as to optimise their effectiveness.

Finally, having achieved proof of concept, we realised that to integrate sound and movement in a meaningful way, we would have to bring in new expertise. The cellist and a sound designer have since worked with us to drive this part of the work forward, playing with different parameters, sound effects and styles of music towards a satisfactory whole. Figure 8 shows the complexity and potential beauty of the sound interface as an integral part of the work.

Having shown how successful a textile design strategy can be through the three backs, we must now work back into the design of the cello garment, and take it beyond the demonstrator aesthetics of the laboratory to meet the same textile creation criteria we hold to be crucial to our practices.

Figure 10: electronic testing of knitted stretch sensor

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Weave: Nigel Marshall

Knit: Martha Glazzard

Embroidery: Tina Downes

Fit: Karen Harrigan

Cello: Peter Gregson

Sound design: Yann Seznec

Electronics: Philip Breedon, Sarah Kettley