Material computing: computing materials

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Material Computing – Computational Materials

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ABSTRACT
Embedding computers into our environment is perhaps not only a job for computer scientist and engineers. We propose to understand the computer as a material for design as means to invite artists, architect, and designers to participate in envisioning how and where the computational power can be used. We will invite the conference attendees to (once again) think about how to bridge the so-called gap between computational and material properties but this time using a material rather than the traditional information centric perspective. The invitation is extended through hands-on experiences with our two samples of computational composites.

Author Keywords Computational Composites, Materials, Design, Ubiquitous Computing, Formgiving

ACM Classification Keywords B.4.2 Input/Output Devices. F.m MISCELLANEOUS

General Terms Design, Theory

INTRODUCTION
The vision of Ubiquitous Computing can be seen as more than the now widespread pads, tabs, and boards. With a vision of computers literally embedded into our environment, however, we may wish to invite other kinds of designers than computer scientists and engineers. We may wish to engage those who have built a long tradition of designing our spaces and artifacts—those who have gained an understanding, not only for the functional aspects, but also for the aesthetical dimensions of our environment. Architects, for instance, understand what it means to move around in space and how to create desirable flows for that, and industrial designers understand what it means to create appealing physical forms for engagement and interaction. To demand thorough technical knowledge of computers from artists, architects, industrial designers, fashion designers etc. (hereafter referred to as designers), is, however, practically impossible—and possibly undesirable.

Others have proposed ways of inviting these groups of professions as well as everyday people into the propagation of technology in our environment. The approach has generally been to inspire a Do It Yourself (DIY) spirit by making tinkering with the technology more approachable [cf., 3]. We build on their important work but argue that to transcend a technological approach to the possibilities of the technology we also need a new way of understanding the it [cf., 5]. We need a way to think about technology that relates it to other elements of these design practices. The computer has been proposed as a material for design on a number of occasions primarily, though, as a conceptual exercise [cf., 4]. Thinking in terms of "computational composites" allows us to combine these two bodies of work and achieve a conceptual framework founded in a physical practice. A computational composite is a composite material where at least one of the materials has computational capabilities.

In this demo/poster, we present two samples of computational composites. Two material samples that embody the idea of the computer as a physical material for design and demonstrate some of the possible expressions and dynamics that computational composites afford.

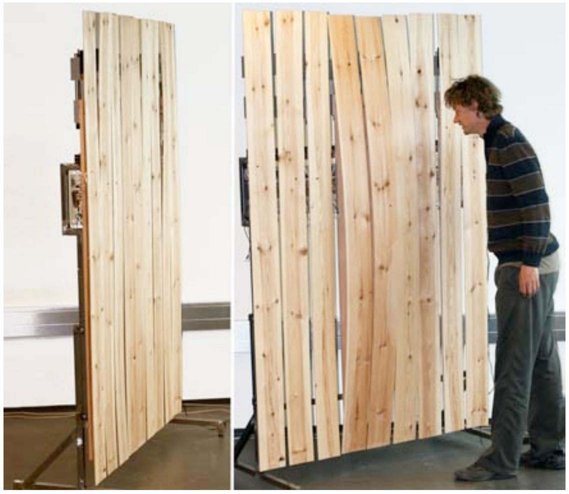

Figure 1 Left: nine PLANKS in their straight position. Right: the PLANKS reacts to sound.

MATERIAL SAMPLE: PLANKS
The PLANKS are 2m long 8mm thin pine planks made to bend as a reaction to sound in their vicinity [1]. The longer the sonic activity the more they bend (see Figure 1). Each PLANK functions individually and can thus be combined and applied quite freely. The PLANKS demonstrate how traditional and familiar materials like wood can achieve new expressions and how the whole body can experience the expressions of computers. The PLANKS are, for instance, suited for wall paneling and room dividers but have no strength for structural purposes. Up to ten

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PLANKS can be powered by the same 12V power supply. The PLANKS comprise, beside the pine plank, a microphone, a motor, a contraction structure, and an Arduino board with an Atmega168 processor.

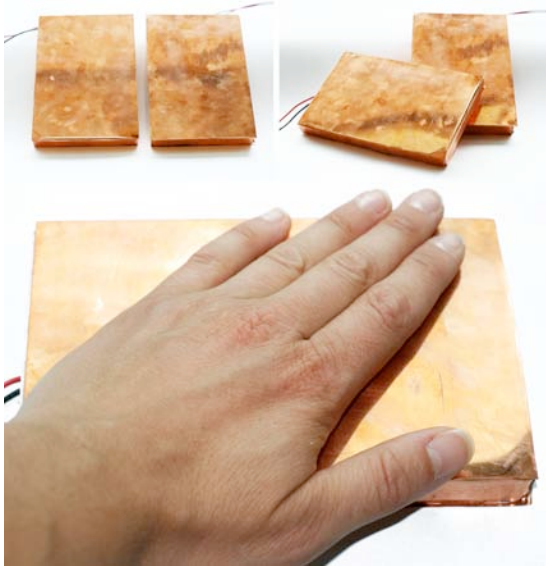

Figure 2 The copper tile cools down when it is heated by the hand

MATERIAL SAMPLE: COPPER TILES

The copper tiles are 14x10x2 cm tiles with two different modes [5]. In one of two modes, a single copper tile reacts to an external flow of thermal energy by reversing the effect of this flow. Hence, when your hand is placed on top of the copper tile – in stead of getting warmer - the tile starts cooling down thereby demonstrating how computational composite provide us with an opportunity to 'play' around with our experience of causalities.

In the second mode, two copper tiles are wirelessly connected and acting as one. By a continual search for thermodynamic equilibrium across the tiles a new common mean temperature is reached by both tiles. Hence, whenever one of the tiles is heated or cooled both tiles will change their temperature. This demonstrates how two separate entities of a computational composite can be experienced as one though separated by distance. And again, how computational composites can provide us with new opportunities to bring about new and unfamiliar experiences with our material surroundings.

Besides copper, each tile comprises a number of Peltier elements, a LilyPad with an Atmega 168 processor, and an X-bee module running a ZigBee protocol for ad hoc networks.

DESIGNING (WITH) COMPUTATIONAL COMPOSITES

The challenge with smart materials like computational composites is that they are highly specified in their expression and functional properties. This makes it undesirable and practically impossible to develop a wide variety and large quantities for an off-the-shelf market. Instead, designing with complex material as these involves designing the material within of the overall design process. Thus, it requires that designers' are knowledgeable of the potential these materials comprise—what they can become and what can be done with them. This knowledge is obtained only through a combination of theory and experience. The experience is necessary to perceive the possibilities of the dynamics in these materials. The changes they exhibit are most often more explicit and instant than more traditional materials; thus, the designers need to gain an embodied sensation of what it means that the materials changes like this in space over time. The theoretical understanding is necessary to navigate the design space that these materials open. To think beyond the few samples experienced and guide the development of new composites and expressions. This theoretical knowledge should not be founded within the paradigm of information technology but should be founded in the understanding of the computer as a material [cf., 5, 6].

The material samples presented here is thus made to spark imagination rather than be technically complete in terms of their ability to sustain advanced use in an application. Their purpose is to demonstrate different expressions—expressions that are now uncommon in a context of computational technology. They play on the notion of the strangely familiar and the para-functional [2].

Exhibiting these two material samples at a conference in Ubiquitous Computing is obviously not to reach an audience of designers but to invite other computer scientist and engineers to participate in the exploration of computational composites.

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