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## Light Arrays

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**Abstract**

The Light Arrays project explores the extension of the body through an array of visible light beams projecting on the environment a dynamic representation of the body, its movement and posture. Interestingly, these light cues are visible both for the user wearing the device as well as for others. The result is an experiential bridge between what we see and what we feel or know about the dynamic, moving body. The Light Arrays afford augmented proprioception, generated through the artificial visual feedback system; enhanced body interaction prompted by the interactively augmented body image (in time and space); as well as a clear visual representation of interpersonal and inter-structural | architectural space.

**Author Keywords**

Light; embodied engagement; performative research; soft electronics; wearable technologies.

**ACM Classification Keywords**

H.5.2 [Information Interfaces and Presentation]: User Interfaces - Interaction Styles, Theory and Methods, User-centered Design.

**General Terms**

Design, Human Factors.

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## Introduction

The Light Arrays consist of three different systems:

*laserSpine*, a series of lasers that protrude perpendicular from the spinal column to extend and magnify the nuances of the spine's orientation. In this module the complex interactivity comes from the body, rather than the technology.

*InertiaLEDs*, a series of LED arrays worn around the limbs or across the torso. These modules are a custom hybrid of soft and traditional electronics. Each LED may be controlled independently. The *inertiaLEDs* have a number of programmed behaviors, each of which affords interaction with movement over time.

*The in-visible skirt*, a series of motorized laser modules worn around the waist such that when they are lit and dynamically repositioned they suggest a striped a-line skirt that moves and sways in response to an external controller. The controller may be worn by the wearer of the skirt or by another person – on their hips or elsewhere on their body. This creates an interesting interaction scenario in which the extended body may be shared between two persons.

## Methods and Related Work

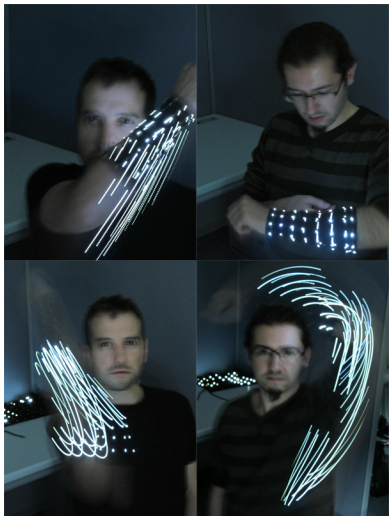
The work evolved out of a performative research methodology [6], undertaken by the authors, with choreographers Alessio Silvestrin, Kentaro!!, and dancer Naoya Aoki.<sup>1</sup> Our approach afforded deep focus on electronic and textile interface research and development, as well as an extended, interwoven design choreographic process [8,14].

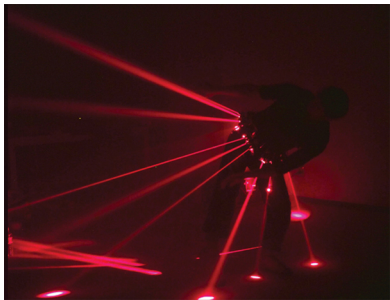
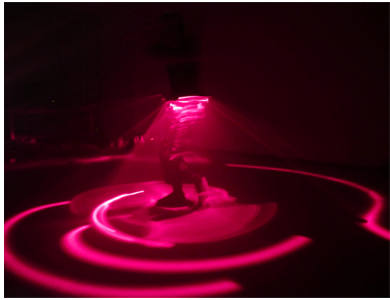
<sup>1</sup> As well as many others throughout the process [11].

The embodied approach used in the development of *hipDisk*, for example, [13,14] was extended from designer to participants. Embodied testing of interim experimental outcomes by people outside of the design process directly informed development of outcomes from the outset. This approach privileged emergent, experientially rich outcomes, and is fundamentally different to more linear, iterative, or predetermined processes typically employed for quantitative or qualitative research.

The systems also build on, complement, and to a certain extent function as the exact reverse, of the Haptic Radar system [2], in which rangefinders are used to extend spatial awareness through vibro-tactile feedback. Rather than gathering information on the objects surrounding the wearer and transducing it into tactile cues, the Light Arrays system gathers information about the wearer's posture, and projects it onto the surrounding for everybody to observe.

Other related work includes Hussein Chalayan's 2008 collection, *Readings* [3], dresses that incorporate servo-driven lasers and crystals. In *Readings*, the lights are driven by servo motors, to refract out from the body in dynamically changing directions. They do not extrude the body in relation to its underlying mechanics. Marey's chronophotographic locomotion studies are more relevant [9], though they extend the body along its surfaces rather than out into space. Marey's work gives us insight into movement as it occurs over time, as well as through space. He presents the body as an integrated whole comprised of linked parts and dynamically shifting relationships. Motion capture provides a contemporary equivalent [5]. The celebrated choreographer and dancer, Merce





Cunningham, said that motion capture technology allows him to “see movement in a way that was always there – but wasn’t visible to the naked eye.” [11] The Light Arrays do the same, but in real time, independent of architecturally based infrastructure. In contrast to motion capture systems, the Light Arrays aim to provide inspiration and insight through real-time feedback, rather than quantifiable data. They are not, in any traditional sense, a technical tool, though applications in disability, rehabilitation and learning are being explored [12, 13, 7]. They evolve in real-time, yet, nonetheless, relate closely to *Synchronous Objects for One Flat Thing, reproduced*, which offers “alternative sites for understanding [choreographer, William] Forsythe’s work and seeing its choreographic structures unfold.” [4] Forsythe’s objects are computer generated graphic overlays and reinterpretations created after the fact, using as their source material the *One Flat Thing, reproduced* choreography: in video form, and as recounted by the dancers and Forsythe.

### Feeding Forward, Feeding Back.

Observers and wearers of the Light Arrays view and experience the system in different ways at any moment in time. This simultaneity of multiple perspectives leads to opportunities to feed forward, in addition to sharing perceived information and providing feedback. Feedback can be understood as the information that a system provides to a participant or user in response to their actions, as well as the highly idiosyncratic feedback each user gains from their body as they give attention to feelings, movements and physical responses that arise while interacting. Feeding forward points to the information that the system’s state communicates beyond the participants, to others. In the case of the Light Arrays, the augmented and

amplified body in motion is literally “fed forward” to create a kind of observable synesthesia for the viewer.

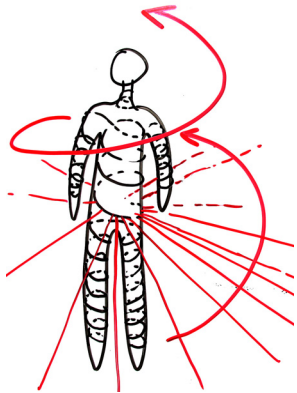
### Reflections

Bloomer and Moore, in *Body, Memory and Architecture* suggest that what is missing from dwellings today are the potential transactions between body, imagination and environment. [1] They propose that the emotional spatiality of the body is social, and claim that it is impossible to imagine spatial organisation “more universal, more valued, and more immediately understandable to everyone than the one provided by the human body.” [1] They suggest that as everyone is conscious of their “spatial” sensibility at one time or another, people are likely curious about that sensibility in others. This curiosity not only allows us to enjoy an external expression of our private feelings but, according to Bloomer and Moore, confirms our own existence in humanity [1].

Light Arrays provide a way of thinking about the transactions that take place between the body, the imagination and the environment from an experiential, as well as visual, perspective. They allow the participant to enter, understand and experiment with the meanings that “find expression along the body’s boundaries, centres, and psychophysical coordinates” [1], as well as with non-observational relationships to space. Echoing Merleau-Ponty’s claim that the paintings of Cézanne “make visible how the world touches us,” [10] the Light Arrays make visible how our gestures touch the world.

### Conclusion

The Light Arrays afford augmented proprioception, which may be useful for learning complex somatic



techniques, speeding-up rehabilitation, and exploring the body's expressive capabilities; enhanced body interaction; and a clear visual representation of interpersonal space. Whether they are used in artistic or pragmatic contexts or frameworks, the different Light Arrays modules afford experientially rich, playful kinesthetic poetic discovery, in which the body is engaged through imaginative exploration, and the imagination through kinesthetic exploration [13]. This coupling of cognitive and kinesthetic load seems to result in richly engaging experiences [13].

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