Sculpted Computational Objects with Smart and Active Computing Materials

by

Margaret A. Orth

B.F.A., Painting, Rhode Island School of Design, 1986
S.M.V.S., Massachusetts Institute of Technology, 1993

Submitted to the Program of Media Arts and Sciences,
School of Architecture and Planning
In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

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Abstract

This thesis presents the creative, technological, and philosophical means and methodology, by which technology artists and researchers can materially and sculpturally transform physical computing technology from hard, remotely-designed, plastic shells, into intimately created, sensual computing objects and artifacts. It asserts that the rigid, square, and prefabricated physical materials of computing technology are a fundamental technological and artistic limitation to anyone who wishes to sensually transform physical computing technology, or develop a rich artistic vocabulary for it. Smart and active sculptural computing materials are presented as a solution to this problem. Practically, smart computing materials reduce the number of separate, rigid, and square prefabricated parts required to create physical computing objects. Artistically, active sculptural computing materials give artists and designers the ability to directly manipulate, shape, experiment with, and therefore aesthetically understand the *real,* physical materials of

computing technology. Such active design materials will also enable creative people to develop a meaningful artistic relationship between physical form and computation.

The total contributions of this thesis include a proposal for a future three-dimensional design/technology practice, a portfolio of sensually transformed expressive computational objects (including new physical interfaces, electronic fashions, and embroidered musical instruments), and the smart and active sculptural computing materials and processes (in this case smart textiles), which make that transformation possible. Projects from the design portfolio include: The *Triangles*, and its applications; *Electronic Fashions*, including the *Firefly Dress and Necklace, New Year's Eve Ball Gown*, and *Serial Suit*; *The Musical Jacket*; *Electronic Tablecloths*; and a series of *Embroidered Musical Instruments* with embroidered pressure sensors. Contributions from the supporting technical area include: the first fabric keypad (a row and column switch matrix), a new conductive yarn capable of tying and electrical/mechanical knot, an advanced process for machine embroidering highly conductive, flexible and visually diverse electrodes, an empirical model of complex impedance sensing, and a definition of and test for the machine sewability and flexibility of yarns. These contributions are presented in three sections: 1) the supporting arguments, and philosophy of materiality and computation behind this work, 2) the design portfolio, and 3) the supporting technical story.

Thesis Supervisor: Tod Machover
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The following people served as readers for this thesis:

Reader _____

John Maeda
Associate Professor of Design and Computation

Reader _____

Neil Gershenfeld
Professor of Media Technology

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