

# A Flexible Tool for the Visualization and Manipulation of Musical Mapping Networks

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## Abstract

This report describes the use of L<sup>A</sup>T<sub>E</sub>X to format a thesis. A number of topics are covered: content and organization of the thesis, L<sup>A</sup>T<sub>E</sub>X macros for controlling the thesis layout, formatting mathematical expressions, generating bibliographic references, importing figures and graphs, generating graphs in MATLAB, and formatting tables. The L<sup>A</sup>T<sub>E</sub>X macros used to format a thesis (and this document) are described.

## Acknowledgments

Acknowledge this, asshole.

## Preface

There are some things I should probably pre-face, certainly not reface.

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various graphs of response time (discussion) screenshot of drawing screenshot of saving/loading screenshot of main view screenshot of grid view

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# List of Acronyms

IDMIL	Input Devices for Musical Interaction Laboratory
MVC	Model View Controller
DMI	Digital Musical Instrument
OSC	Open Sound Control
GUI	Graphical User Interface

# Chapter 1

## Introduction & Motivation

1.1 Context and Motivation

1.2 Project Overview

1.3 Thesis Overview

1.4 Contributions

# Chapter 2

## Background

### 2.1 Mapping

### 2.2 Interface Design

#### 2.2.1 MVC

### 2.3 Visual Design

### 2.4 All my citations

#### 2.4.1 Mapping

1. GDIF: [1]
2. disembodied performance
3. Wanderley's mapping paper [2]
4. surely some other stuff from class

#### 2.4.2 Data Visualization

1. Allosphere? :[3]
2. Heirarchical edge bundling: [4]

3. Tukey: [5]
4. Envisioning information: [6]
5. Beautiful Evidence: [7]
6. The other Tufte book I have at home.

### 2.4.3 User Centered Design

1. Main [8]
2. I have 2 others

### 2.4.4 User Interfaces

1. Inclusive interconnections [9]
2. Integra [10]
3. Jamoma [11]
4. Junxion [12]
5. MPG Care Package [13]
6. Sense Stage [14] Braun, patchage, osculator, eaganmatrix

### MVC

1. MVC Krasner Pop [?]

### 2.4.5 Libmapper

1. OSC: [15]
2. Vizmapper [16]
3. joe's libmapper paper: [17]
4. joe's other paper? (earlier), his master's thesis

## Chapter 3

# Design & Implementation

Development of a graphical user interface for libmapper creates a unique challenge. Obviously such an interface is a practical tool, and should function as such, yet it also must work in concert with DMIs which are inherently designed for abstract and creative use. For the purposes of this project, the assumed solution to this innate paradox is to provide the user with multiple independent modes of control. This assumption was made based on experiences with prior user interfaces for libmapper (vizmapper, max mapperGUI): for each interface users reported excellent functionality for certain use cases, and poor functionality for others. Libmapper itself is an extremely flexible API that makes few assumptions as to the network of devices and signals, nor how they are being mapped. It is fitting that a GUI for libmapper would be equally as flexible. In lieu of a single perfect solution for network visualization and interactivity, providing users with various independent solutions provided a good compromise.

### 3.1 User Centric Design

use cases

## 3.2 Development of a “Modular” Interface

### 3.3 The Model-View-Controller

Because a modular design is desired, the Model-View-Controller (MVC) metaphor for structuring software applications as described in [KrasnerPope88] was used as a general framework for structuring the application. In fact, the whole scale swapping in and out of independent visual modes can be thought of as a quintessential implementation of MVC.

#### 3.3.1 The Model

The model consists of an abstract copy of the network, residing on the local machine. Independent views can consult this data, but cannot directly modify it.

#### 3.3.2 Controller-View Pairs

## 3.4 Graphical Design

wiggly arrows

#### 3.4.1 Typography

## 3.5 Robustness and Responsiveness

speed tests

# Chapter 4

## Results & Discussion

### 4.1 Undoing and Redoing in a Collaborative Distributed Environment

### 4.2 Edge Use Cases

### 4.3 User Feedback

### 4.4 Modular vs Hard-Coded

#### 4.4.1 Was the approach successful?

Are sections graphically unified? (Is this even necessary?)

### 4.5 Visualization vs Interaction

### 4.6 Different namespaces

# Chapter 5

## Conclusions & Future Work

### 5.1 Summary and Conclusions

### 5.2 Future Work



## References

- [1] A. R. Jensenius, T. Kvifte, and R. I. Godøy, “Towards a gesture description interchange format,” in *Proc. of the 2006 International Conference on New Interfaces for Musical Expression (NIME06)*, pp. 176–179, 2006.
- [2] A. Hunt, M. M. Wanderley, and R. Kirk, “Towards a model for instrumental mapping in expert musical interaction,” in *Proc. of International Computer Music Conference (ICMC 2000)*, pp. 2–5, 2000.
- [3] T. Höllerer, J. Kuchera-Morin, and X. Amatriain, “The allosphere: A large-scale immersive surround-view instrument,” in *Proc. of Workshop on Emerging Displays Technologies*, pp. 21 – 28, ACM Press, 2007.
- [4] D. Holten, “Hierarchical edge bundles: Visualization of adjacency relations in hierarchical data,” *IEEE Transactions on Visualization and Computer Graphics*, vol. 12, pp. 741–748, September/October 2006.
- [5] J. W. Tuckey, “The technical tools of statistics,” *The American Statistician*, vol. 19, pp. 23–28, April 1965.
- [6] E. R. Tufte, *Beautiful Evidence*. Graphics Press, 2006.
- [7] E. R. Tufte, *Envisioning Information*. Graphics Press, 1990.
- [8] R. Kling, “The organizational context of user-centered software designs,” *MIS Quarterly*, vol. 1, pp. 41–52, December 1977.
- [9] G. Booth, “Inclusive interconnections: Towards open-ended parameter-sharing for laptop ensemble,” Master’s thesis, University of Huddersfield, Huddersfield, England, 2010.
- [10] J. Bullock, D. Beattie, and J. Turner, “Integra live: a new graphical user interface for live electronic music,” in *Proc. of International Conference on New Interfaces for Musical Expression*, pp. 387 – 392, 2011.

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- [11] T. Place and T. Lossius, “Jamoma: A modular standard for structuring patches in max,” in *Proc. of International Computer Music Conference (ICMC 2006)*, 2006.
  - [12] STEIM, “Junxion - products of interest,” *Computer Music Journal*, vol. 28, pp. 105–107, Summer 2004.
  - [13] N. Wolek, “The mpg carepackage: coordinating collective improvisation in max/msp,” in *Proc. of the Society for Electro-Acoustic Music in the United States (SEAMUS 2010)*, 2010.
  - [14] M. Baalman, V. de Belleval, C. L. Salter, J. Malloch, J. Thibodeau, and M. M. Wanderley, “Sense/stage - low cost, open source wireless sensor infrastructure for live performance and interactive, real-time environments,” in *Proc. of Linux Audio Conference*, pp. 242–249, 2010.
  - [15] M. Wright and A. Freed, “Open soundcontrol: A new protocol for communicating with sound synthesizers,” in *Proc. of International Computer Music Conference (ICMC 1997)*, pp. 101–104, 1997.
  - [16] V. Rudraraju, “A tool for configuring mappings for musical systems using wireless sensor networks,” Master’s thesis, McGill University, Montreal, Canada, December 2011.
  - [17] J. Malloch, S. Sinclair, and M. M. Wanderley, “A network-based framework for collaborative development and performance of digital musical instruments.,” *R. Kronland-Martinet, S. Ystad, and K. Jensen. (Eds.): CMMR 2007, - Proc. of Computer Music Modeling and Retrieval 2007, Conference, LNCS 4969. Berlin Heidelberg: Springer-Verlag*, pp. 401–425, 2008.