Chapter 5

The Hypothesis

Overview

This chapter restates the hypothesis made at the start of this thesis and examines it in more detail by summarising recommendations from the first four chapters.

5.1 Discussion of the hypothesis

> **The real-time control of computer-based musical instruments can be enhanced by the provision of non-analytical performance modes in the user interface.**

This statement concerns the user interface in computer systems which are used for music generation. It is less concerned with the physical form of the interface (joystick, mouse, keyboard etc.) than the *mode* of interaction between musician and computer. There are aspects of traditional musical performance (with acoustic instruments) which would appear to be entirely absent from many of today's computer interfaces. Typical computer interfaces could be generalised as being *analytical*, thus requiring linear, sequential thought processes which may not lend themselves to musical expression.

This study claims that if the aspects of musical performance interaction (known as *performance mode*) can be incorporated into user interfaces, then a deeper and more expressive level of real-time control will be possible for the musician using the computer system.

The previous chapters of this report are now reviewed in the context of this hypothesis.

5.2 Review of Ch. 2: Human Computer Interaction

Chapter 2 described various philosophies of Human Computer Interaction and suggested that most interfaces are designed for the lowest common denominator of human input; i.e. a simple interface which is as easy to use by as many people as possible. Human-computer dialogue is therefore either dominated by the computer's prompting (*linear* progression through a dialogue), or human choice from a limited set of options (referred to as *menus* if text based or *icons* if presented pictorially). Both of these scenarios put the human operator in a position of having to read, think, interpret, and react in a discrete manner to the computer, i.e. to be *analytical*. The potential intimacy between operator and the device being controlled is impoverished, which has serious implications for the control of many real-time systems.

The *direct manipulation* paradigm has attempted to give users a greater sense of controlling objects, but to date many such systems still rely upon menus and the visual display of information. An important goal for the control of complex real-time systems is the direct manipulation of multiple parameters (allowing continuous changes) and the provision of feedback via many human sensory channels. The design of systems which allow their operators to be *explorative* (and to discover *holistic* relationships between system parameters) is difficult, but should be pursued in some detail.

Chapter 2 also described some 'suggested areas of change'. These can be summarised as follows:

- Humans should become the active controllers (*actors*) of dynamic systems rather than passive monitors, responding to computer-controlled dialogue.
- We should seriously question the 'ease of use' design philosophy which rules out human learning and thus the development of control intimacy.
- Research and development is required into alternative methods of interaction to the accepted menus/information paradigm for real-time system control. Systems should make more use of processes which become automatic to the user (through practice) to allow humans to cope in stressful situations.

5.3 Review of Ch. 3: HCI in Computer Musical Instruments

Chapter 3 examined HCI in computer music systems, but drew some general conclusions regarding the capabilities of a human operator, which can be summarised as thus:

- Humans need to be motivated by the actual process of machine/instrument interaction. With enough motivation people will spend large amounts of time practising, rehearsing and adapting to new systems.
- Time spent learning a new system can be rewarded by an increase in control intimacy. Systems that are intended for large amounts of user contact time or for use in dynamic or safety-critical situations should facilitate *scalable control intimacy*.
- As control intimacy increases, users tend to rely less on visual presentation of textual (or even graphical) data. Other methods of feedback must be developed, especially where a user's visual attention needs to be elsewhere.
- The development of *Performance Modes* is proposed for a variety of systems. These would allow users to explore a control environment and discover relationships and control methods in a holistic manner, rather than being constrained to a fixed computer dialogue.

5.4 Review of Ch. 4: Cognitive Models for Performance Interaction

Chapter 4 explored the constituent factors of Performance Mode and contrasted them with the traditional 'analytical' mode of human thought which pervades HCI design. The attributes which would seem to be required to implement this mode of operation were described as follows:

- There should be no fixed ordering to the human-computer dialogue.
- The human takes control of the situation. The computer is reactive.
- There is no single permitted 'set of options' (e.g. choices from a menu) but rather a series of continuous controls.
- The main goal is the overall control of the system (under the direction of the human operator), rather than the ordered transfer of information.

- The control mechanism is a physical and multi-parametric device which must be learnt by the user until the actions become automatic.
- Further practice usually develops the user's control intimacy and thus increased competence of operation.
- The human operator, once familiar with the system, is free to perform other cognitive activities whilst operating the system (e.g. talking while driving a car).

The major reason for converting to such human-centred designs is to allow human operators to work at something like their full capacity. Interfaces should make use of attributes that the human body and mind seem to be most capable. This will ensure that greater subtlety of human control is permitted in those situations where the system programmer has not anticipated all eventualities.

5.5 Computer Instruments

Devices are sometimes referred to in the literature as computer *instruments* even when they are not designed for live performance; rather for non-real-time editing operations. The increasing processing speed of computing technology means that real-time operation is now possible. However, designers often simply translate the editing paradigm onto a faster processor in order to get 'real-time performance'. We propose here that 'fast analytical editing', whilst being a laudable goal in its own right, is completely different from creative performance. A human player requires an instrument that can be continuously controlled in a subtle manner without having to enter into traditional human-computer dialogue.

The *MidiGrid* software, referred to in chapters 3 and 4, involves the direct manipulation of sonic objects and has proved to be successful at engaging human players in an explorative mode of operation. Various aspects of its interface may be used as guidelines for the design of new performance instruments. These attributes may be summarised as:

- The absence of a fixed HCI dialogue.
- Instant response to the user's movements.
- Repeatability; similar movements produce similar musical results.

- The primary feedback is sonic and tactile. Visual feedback is also provided but advanced users make less use of this.
- Scalable control intimacy. Beginners can immediately make sounds, but further practice allows increased control.
- The Performance Mode is the user's first point of contact with the instrument. Editing is possible as a secondary option.
- A configurable layout; the interface can be customised to suit different users. However it is noted that the continuous reconfiguration of a performance interface for an individual user could be counter-productive.

5.6 Editing - in holistic mode

It should be noted that in a good system many of the facets of live performance *could* be present at the editing stage. Editing and reconfiguration generally involve a great degree of analytical thought, so it is appropriate that menu-options and iconic tools be present to facilitate such actions. However, the explorative operation outlined in chapter 4 could be applied to creative editing just as much as to live performance.

For example, should the task of 'creating a new sound' be entirely a case for navigating menu options and entering parameter values? Would it not be better to allow the user to have access to the same type of explorative direct manipulation techniques as outlined above? In this way, the act of editing becomes an active physical process, utilising instant feedback from gestures. Cognitive analysis and parameter adjustment can be used at any point *that the user feels is appropriate*, rather than being the only option for changing the sound.

5.7 Summary

The Hypothesis can be summarised as follows:

> **Non-analytical modes in the HCI of musical computer systems will improve real-time performance.**

The next chapter formulates a work-plan to test this hypothesis in a series of user interface tests.