Chapter XII
Pen-Based Interaction for Intuitive Music Composition and Editing

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ABSTRACT

This chapter deals with pen interaction and its use for musical notation composition and editing. The authors first present existing pen-based musical notation editors and argue that they are dedicated to classical musical notations and are often constraining for the user. They then focus on their generic method that is in particular based on a formalism that models how to interpret the strokes drawn in online structured documents. To analyze an element, it models a coupling of a global vision (its position relatively to the other elements of the document) with a local vision (its shape and that of its components). The authors also present the hand-drawn stroke analyzer associated to this formalism. Finally, they demonstrate how the presented method can be used to design pen-based systems not only for classical musical score notations, but also for plainchant scores, drum tablatures and stringed-instrument tablatures.

INTRODUCTION

This chapter deals with a new computer system approach, based on pen interaction, for music composition and editing: thanks to a pen, the user creates and modifies digital documents by drawing on a touch screen. The use of a pen is very intuitive, because it reproduces the “paper-pen” metaphor, media everybody knows: it makes it possible to use computer systems the same way as a sheet of paper. Figure 1 presents a tablet PC, which is a computer system with such an interaction: the user writes musical scores in a traditional way by drawing the symbols on the screen. This system is an example of system developed thanks to the methodology presented in this chapter: the user draws musical...
symbols the same way as on paper. The drawings are recognized and retranscribed neatly directly as the user composes the document. The user can then check the recognition process and interact with the system to easily modify the document, for instance move some of its elements, erase them, and so forth.

Pen-based interaction offers various advantages for the composition and the editing of digital documents. Indeed, the user can benefit from the possibilities of both paper and computer systems. On the one hand, the user can write symbols as he usually does on paper. As stated by many authors, like for instance Anstice, Bell, Cockburn, and Setchell (1996), Macé and Anquetil (2006a) or George (2003), it is more user-friendly and faster than classical mouse-based composition and editing systems which consist in clicking on a menu to select a symbol and dragging it to the appropriate place. Moreover, as presented in Figure 1, a tablet PC is almost as mobile as a sheet of paper, which simplifies its use in various situations. On the other hand, computer systems offer a direct retranscription which is easier to read than hand-drawn symbols. The user can also easily modify the documents, erase or move some of their components, copy, cut and paste some of them, and so forth, and then avoid the loss of quality and neatness of the paper document.

Finally, the user benefits from the traditional computer functionalities; for example, a digital musical score can be played, perfectly formatted, archived, distributed, and so forth.

Actually, there are very few pen-based interfaces for digital document composition and editing, and in particular for musical notations. This is due to the fact that developing such systems is complex. Indeed, the recognition of symbols drawn on the touch screen is a difficult problem of pattern recognition due to the diversity of handwriting styles. This recognition process is even more complex in the context of highly structured document analysis, since these documents are constituted of many elements of various natures. Moreover, a same drawing can have different meanings according to the context in which it has been realized, which must therefore be taken into account.

This chapter deals with the exploitation of pen interaction to compose and edit structured documents, and, more specifically, documents with musical notations. Before going further, let us introduce the vocabulary used in this chapter. We use the word composition for the action of writing music symbols, and the word editing for the action of modifying one or more of these symbols or more generally the document. We designate as structured documents, documents which present a predefined structural arrangement, and for which it is possible to express composition conventions, that is the way they are classically drawn. Concerned documents come from various domains, such as diagrams, plans, electronic figures, and so forth. Traditional musical scores, plainchant scores, drum tablatures or stringed-instrument tablatures are examples of structured documents with musical notations that we are going to focus on in this chapter. Online interpretation deals with the interpretation of the hand-drawn user strokes, which are the sequences of points captured by the touch screen between a pen-down and a pen-up. Online interpretation can be either lazy (i.e., occurring only when explicitly