Abstract

This chapter describes the issues involved in the detection and removal of stavelines of musical scores. This removal process is an important step for many Optical Music Recognition systems and facilitates the segmentation and recognition of musical symbols. The process is complicated by the fact that most music symbols are placed on top of stavelines and these lines are often neither straight nor parallel to each other. The challenge here is to remove as much of stavelines as possible while preserving the shapes of the musical symbols, which are superimposed on stavelines. Various problematic examples are illustrated and a detailed explanation of an algorithm is presented. Image processing techniques used in the algorithm include: run-length coding, connected-component analysis, and projections.
Introduction

One of the initial challenges in any Optical Music Recognition (OMR) system is the treatment of the staves. For musicians, stavelines are required to facilitate reading the notes. For the machine, however, it becomes an obstacle for making the segmentation of the symbols very difficult. The task of separating background from foreground figures is an unsolved problem in many machine pattern recognition systems in general.

There are two approaches to this problem in OMR systems. One way is to try to remove the stavelines without removing the parts of the music symbols that are superimposed. The other method is to leave the stavelines untouched and devise a method to segment the symbols (Bellini, Bruno & Nesi, 2001; Carter, 1989; Fujinaga, 1988; Itagaki, Isogai, Hashimoto & Ohteru, 1992; Modayur, Ramesh, Haralick & Shapiro, 1993).

In the OMR system described here, which is part of a large document analysis system, the former approach is taken; that is, the stavelines are carefully removed, without removing too much from the music symbols. This decision was taken basically for three reasons:

(1) Symbols such as ties are very difficult to locate when they are placed right over the stavelines (see Figure 1).

(2) One of the hazards of removing stavelines is that parts of music symbols may be removed in the process. But due to printing imperfection or due to damage to the punches that were used for printing (Fujinaga, 1988), the music symbols are often already fragmented, without removing the stavelines. In other words, there should be a mechanism to deal with broken symbols whether one removes the stavelines or not.

(3) Removing the stavelines simplifies many of the consequent steps in the recognition process.
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