Generation of Approximate Weave Diagrams via Warp Pick Up Assignment [*]

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Abstract

Besides automatic looms in factories, looms for hand-weaving have also been used at home for producing handicrafts. Since the number of healds is small in rigid looms, it is necessary to pick up warp yarns by hand for each weft yarn. This operation is rather cumbersome when the sequences of warp yarns to be picked up are irregular. This paper proposes a method for generating approximate weave diagrams via warp pick up assignment. We represent the difference of weave diagrams in terms of tiling and image features to reflect their topological char-acteristics. Based on this representation, we propose a sequential re-assignment algorithm to generate approximate weave diagrams. The properties and time complexity of the proposed algorithm are reported. The proposed approach is validated in terms of the performance of the algorithm and woven fabric.

Keywords: rigid loom; hand weaving; weave diagram; approximation

1   Introduction

Consumer textiles are usually manufactured by automatic looms in factories. However, looms for hand-weaving have also been used in studios for fabric designers or at home for producing handicrafts [10, 15]. Among various types of table looms, rigid looms are relatively inexpensive and easier to use at home. Figure 1 shows an example of rigid loom. Since the number of healds is small in rigid looms, the variations of weavable patterns are rather restricted, compared with looms with many healds. Still, it is possible to weave complex textiles using rigid looms, by picking up warp yarns by hand for each weft yarn [10, 15]. Figure 2 shows an example of warp picking up process with a stick. However, when the sequences of warp yarns to be picked up are irregular, this process is time-consuming and cumbersome to avoid mistakes.

Toward reducing the burden of weaving textiles using rigid looms, this paper proposes a method for generating approximate weave diagrams via warp pick up assignment. We represent the difference of weave diagrams in terms of tiling and image features to capture topological characteristics

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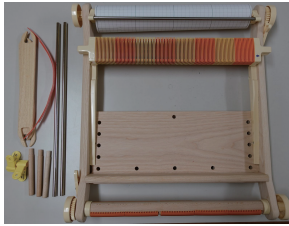*Email address:* tyoshida@cc.nara-wu.ac.jp (Tetsuya Yoshida).
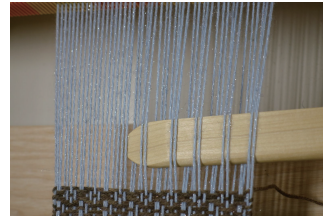
Fig. 1: A rigid loom

Fig. 2: Warp pick up

of weave diagrams. Based on this representation, we propose a sequential re-assignment algorithm to generate approximate weave diagrams. The proposed approach is implemented and validated in terms of the performance of the algorithm and woven fabric.

Section 2 explains the matrix representation of woven fabric. Section 3 explains our proposal for generating approximate weave diagrams, and its validation is reported in Section 4. Section 5 describes concluding remarks and future directions.

2   Representation of Woven Fabric

2.1   Woven Fabric

It is necessary to specify which of warp or weft yarn is over at each intersection on woven fabric. Intersections are represented by fields of black and white cells in a weave diagram, and black cells indicate that warp yarns are over at the intersections. In general, there are repetitions of a pattern in a weave diagram, and the smallest unit of repetition is called a weave repeat in textile. We assume that a weave diagram corresponds to a weave repeat of woven fabric in this paper.

Figure 3 illustrates the mechanism of a hand weaving loom. Each heald is attached to a heald frame, and heald frames are connected to treadles. When a user steps on a treadle, the connected healds go up or down to make the opening of warp yarns. Woven fabric is produced by transporting a weft yarn through the opening.

In order to produce woven fabric, it is necessary to specify (1) when treadles are stepped on, (2) how to connect heald frames and treadles, and (3) which heald each warp yarn goes through. These are represented as a treadling diagram, a tie-up diagram, and a threading draft diagram, respectively. These diagrams are represented as a weaving draft [10, 15], as shown in Fig. 4.
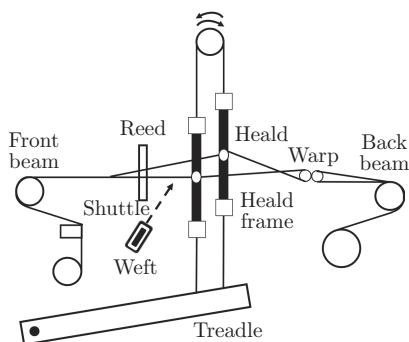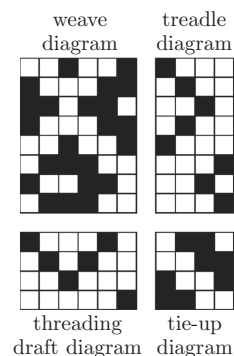

Fig. 3: A hand weaving loom

Fig. 4: Weaving draft