

# Garment Pleats Modeling and Force Analysis Based on Different Yarn Directions<sup>\*</sup>

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## Abstract

Pleating is a common modeling technique in the manufacturing of garments. As requirements for the style of pleats are gradually increasing, it is necessary to consider the pleats modeling and force conditions. In this paper, draping experiments were carried out with the warp yarn on horizontal, vertical, and a 45° angle (bias) for three types. After analyzing the modeling garment pleats, force conditions and comparing the angle of the resultant force, it can be concluded that the modeling and the force of the pleats varies with the direction of the yarn. The species of pleats are different and their modeling is forced differently. The results demonstrate that the modeling of draped pleats and sunray pleats-upper-length are mainly affected by gravity, the bias fabric was desirable in terms of roundness, symmetry and softness. For sunray pleats-whole-length style, the neckline, modeling, quantity and size of pleats, the stability of hem, and the effect of force should be rationally utilized to achieve the optimal styling. The modeling of mummy pleats was greatly affected by the stretch, the bias stripes were the optimal choice.

*Keywords:* Pleat; Warp Direction; Draping; Modeling; Force Analysis

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## 1 Introduction

The pleats element has a long history in the garment industry and has always been a focus for designers, especially in the design of dresses. In the design of pleats, it is easy to ignore the relationship among the modeling, the force conditions and the yarn direction of garments. The most common factors in life, such as gravity and elasticity, will have different influences on the fabric, thus affecting the modeling of pleats, making it less comfortable and ruins the aesthetics. The number of pleats, stretching and deformation of different yarns are closely related to the force. Most woven fabrics are made of warp and weft yarns. The warp direction is the direction parallel to the selvedge of the fabric, and the weft direction is perpendicular to the selvedge of the fabric. A diagonal line through the intersection of warp and weft is the bias. However, the

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effect of the force in the direction of warp, weft, bias yarn is very different, not isotropic, so the effect of the garment pleats modeling varies differently.

In domestic and abroad, there have a lot of research on the mechanical influence of garment pleats. In the last century, foreign researchers Chu CC [1, 2] and others studied warp and weft bending stiffness, the diagonal bending stiffness of the fabric, and the relationship between the fabric drape and stiffness. Lojen and Jevsnik [3] studied the drape properties of fabrics by calculating the drape profile, coefficients and segmented wavelengths. Bardl [4] proposed an automated method for determining local yarn orientation in three-dimensional draped, multi-layered fabrics, as well as pleated fabrics modeling. On the other hand, domestic research have focused on the effect of the yarn direction on the style and the mechanical properties of the fabric. Jiang Hongying [5, 6], discussed the application of across-the-grain in draping of garment pleats. Jin Fengtiao [7] and Li Jun [8] have studied the modeled ability of bias fabrics to better improve the appearance of garment. Li Lisha [9] proposed the force rules for warp, weft, and bias yarn pleats. In this paper, draping experiments of different warp directions of draped pleats, sunray pleats, and mummy pleats were conducted, the modeling and force of pleats were analyzed.

## 2 Experimental Methods

### 2.1 Preparation for Experiment

Cotton muslin with medium thickness was selected as experimental fabric. The iron, pins, dress make's shear, tape, ruler, mark line and woman manikin (160/84a) were prepared for draping. Before experimenting, the primary mark line was affixed to the manikin. Muslin was pre-cut and ironed.

### 2.2 Experimental Methods

In this paper three kinds of pleats commonly used in dresses, namely draped pleats (draped collar and draped skirt), sunray pleats and mummy pleats, were studied. The conventional plain fabric-muslin was used in the experiment. Draping experiments were carried on with the warp yarn on horizontal, vertical, and a 45° angle (bias) for all the types [10].

#### 2.2.1 Draped Pleats

Draped pleats are mainly used in the neckline, sleeve and skirt to form draped effect [11,12]. In this paper, draped collars (Fig. 1) and draped skirts (Fig. 2) were studied as examples. Draping



Fig. 1: Draped pleats-draped collar



Fig. 2: Drape pleats-draped skirt