Topics

Stress Analysis of Airbag Textile by Particle Simulation Method

Tsuyoshi Nomura, Computational Material Engineering Lab.

1. Introduction

The cloth used for airbags must be flexible for passenger protection and should also be strong. To satisfy both strength and flexibility, the weaving structure is important but its relationship to flexibility is not clear. Therefore, we have developed and applied stress analysis to airbag textiles using the particle simulation method.

2. Textile Stress Analysis by Particle Simulation Method

Particle simulation is a calculation method for modeling textiles as a link of spheres, which can represent each yarn in the cloth.

The minimum cloth unit (consisting of two warp and two woof (weft) yarns each) of the weaving structure is arranged in a periodic boundary by making use of the cloth periodicity. Yarn models in which seven filament models each linking 13 spheres are woven make up the cloth model (**Fig. 1**). The spheres are shown as cylinders in the figure. In the filament model, the restoring force corresponding to the elastic modulus of the yarn working against the tensile force acts on each pair of adjacent spheres.

The dynamic calculation of spheres is made by applying bending deformation while keeping a constant curvature to calculate the deformed shape and the force applied to each filament, and then the bending torque applied to the cloth is calculated.

3. Comparison with Experiment

The torque applied to the cloth during bending deformation is measured using a KES bending tester. In this method, the torque applied to one end is measured while rotating the other end of the test specimen so as to cause deformation with a constant curvature. Two types of plain-woven fabrics woven with different tensions were used as specimens with different flexibility levels. Fig. 2 shows the calculated and experimental bending torque values. The experiment shows hysteresis. The upper side shows the values in the loaded state and the lower side are the values in the released state. The calculated curves are the results of simulation with a load applied from the beginning. Good matching with the experimental values was confirmed for both the hard and soft cloths.

4. Summary

We have analyzed the flexibility of airbag textiles by applying the particle simulation method to the stress analysis. The result of the simulated KES bending test of two cloths different in tactile sensation showed good matching with the experimental results. This technology has been summarized as a textile stress analysis system that can be executed on personal computers for use in designing fabrics.

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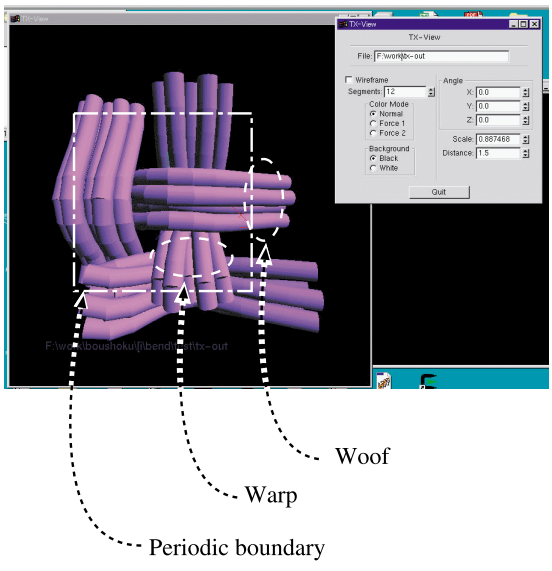

Fig. 1 Particle simulation model of cloth.

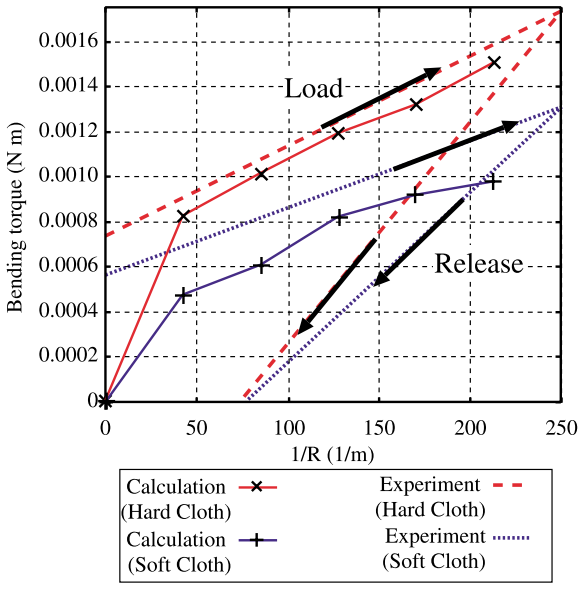

Fig. 2 Comparison of calculated and measured bending torque of hard cloth and soft one.

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