

Deformation Analysis and Processing Stability Assessment for Fabric Specimens with Local Defects or Seams Based on Inflatable Bulging Test

Y.Z. Shen, T. Ma, G.C. Lin, H.F. Tan*

* National Key Laboratory of Science and Technology for National Defence on Advanced Composites in Special Environments, Harbin Institute of Technology, Harbin 150001, China
tanhf@hit.edu.cn

Abstract

Local defects and seams of fabric materials have a certain effect on the performance of inflatable structures, especially in the inflatable deformation. This paper focuses on the analysis of inflatable surface deformation for the fabric materials with local defects and seams, as well as the assessment of processing stability. According to the common defects or seams on the local surface of the inflatable structure, several fabric specimens with local defects and seams are designed and processed, including the fabric specimen with weft deviation, the fabric specimen with the cross-shaped seam, the fabric specimen with the seams and the fabric specimen with the defects. Based on a special designed inflatable bulging device and combined with the digital image correlation technology, a set of test methods for surface deformation of fabric specimens are introduced. Surface deformations for each fabric specimen are calculated by the correlation algorithm under inflated pressures, including the out-of-plane displacement and the full field principal strain of the surface for the fabric specimens. Combining with the finite element numerical results, surface deformations of the fabric specimens with defects and seams are simulated. And the relationship of the surface displacement and strain for the fabric specimens with inflated pressure and position is characterized. Furthermore, the processing stability of the fabric specimens is assessed. This paper will provide test results for the following optimization design of the inflatable structures and the fabric specimens as well as the improvement of the processing stability.

References

- [1] X.L. Luo, H.F. Tan, G.C. Lin and Y. Lian, “Strain Field Measurements Using Digital Photogrammetry for Large Inflatable Structures”, *Experimental Techniques*, vol. 41, pp. 453-462, 2017.
- [2] S. Naboulsi, “Investigation of geometric imperfection in inflatable aerospace structures”, *J Aerospace Eng*, vol. 17, pp. 98-105, 2004.
- [3] M.A. Sutton, J.H. Yan, V. Tiwari, H.W. Schreier, and J.J. Orteu, “The effect of out-of-plane motion on 2D and 3D digital image correlation measurements”, *Opt Laser Eng*, vol. 46, pp. 746-757, 2008.
- [4] X.L. Luo, H.F. Tan and G.C. Lin, “Experimental investigation of in-plane shear performance for F-12 aramid fabric”, *Acta Materiae Compositae Sinica*, vol. 35, pp. 591-598, 2018.

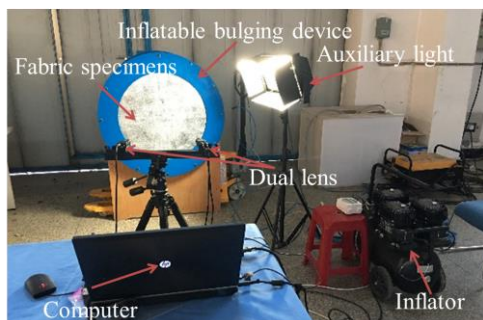


Fig.1 Inflatable bulging test for fabric specimen.

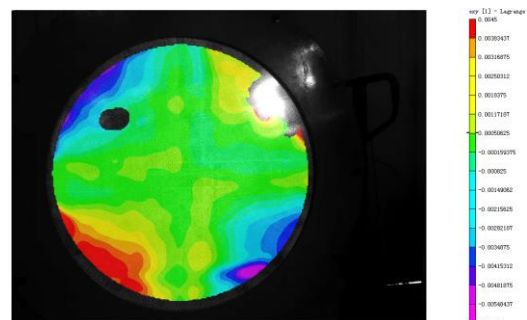


Fig.2 Principal strain cloud of the surface for fabric specimen with the cross-shaped seam.