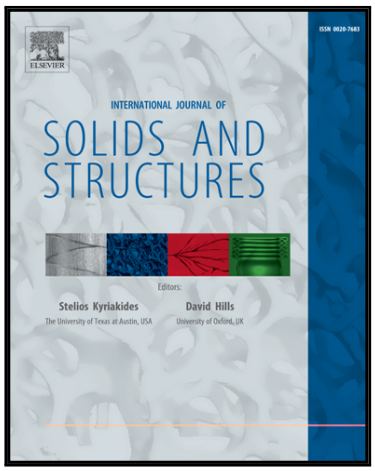

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PII: S0020-7683(16)30223-2
DOI: 10.1016/j.ijsolstr.2016.08.013
Reference: SAS 9273

To appear in: *International Journal of Solids and Structures*

Received date: 20 February 2016
Revised date: 26 July 2016
Accepted date: 19 August 2016

Please cite this article as: Manan Arya, Nicolas Lee, Sergio Pellegrino, Crease-Free Biaxial Packaging of Thick Membranes with Slipping Folds, *International Journal of Solids and Structures* (2016), doi: 10.1016/j.ijsolstr.2016.08.013

Crease-Free Biaxial Packaging of Thick Membranes with Slipping Folds

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Abstract

This paper presents a novel scheme to biaxially package and deploy flat membranes, in which the thickness of the membrane is accounted for through the novel concept of slipping folds. The membrane is divided into parallel strips connected by slipping folds, and specially chosen wrapping profiles that require zero slip along the edges of the membrane are identified. This packaging scheme avoids the kinematic incompatibilities that in other schemes result in local buckles and wrinkles that increase the deployment force and permanently deform the membrane. The paper also presents a scheme to apply uniform uniaxial prestress to the deployed membrane, as well as a two-stage deployment scheme. Packaging efficiencies of up to 83% have been demonstrated for meter-scale models, although for large membranes the packaging efficiency approaches 100%.

Keywords: origami, thick membranes, deployable structures, packaging

1. Introduction

Membranes are widely used in large-area space structures, including photovoltaic arrays, solar sails, drag sails, reflectors, transmissive optics, thermal shields, etc. These applications require tight packaging of the membranes for

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