

Shells and membranes: Grace under pressure

Michael Ortiz

GALCIT 75th Anniversary



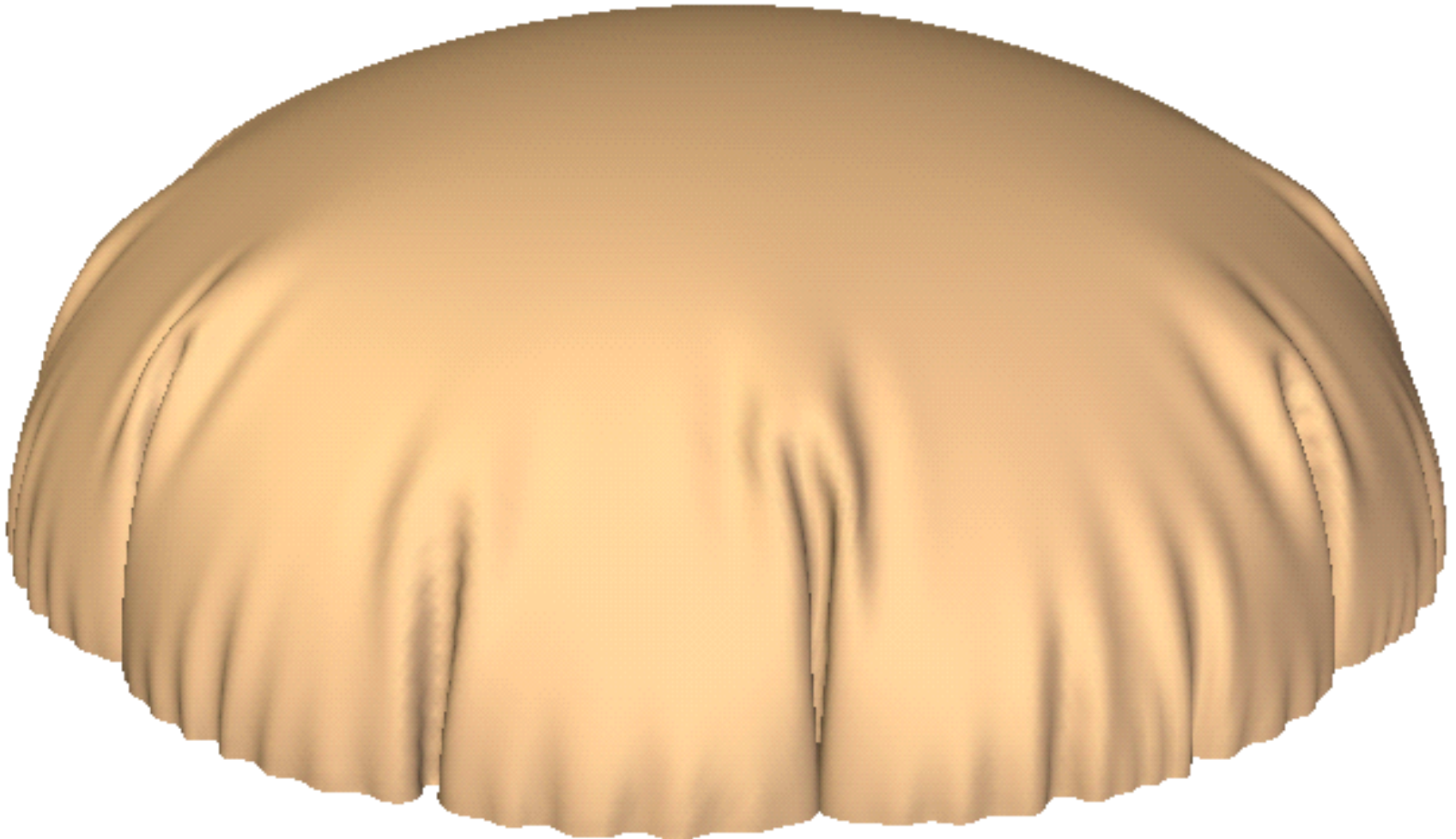
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Membrane and Shell Structures

- Thin flexural structures, when properly designed, combine low weight and stiffness
- Membranes and shells are fundamental components in many aerospace structures, from aircraft to telescope systems
- The ability to simulate shell deflections and failure is key to their effective design, reliability and safety assessment
- The following is a collection of some of my favorite applications of shell mechanics



Shell finite elements - Circular airbag



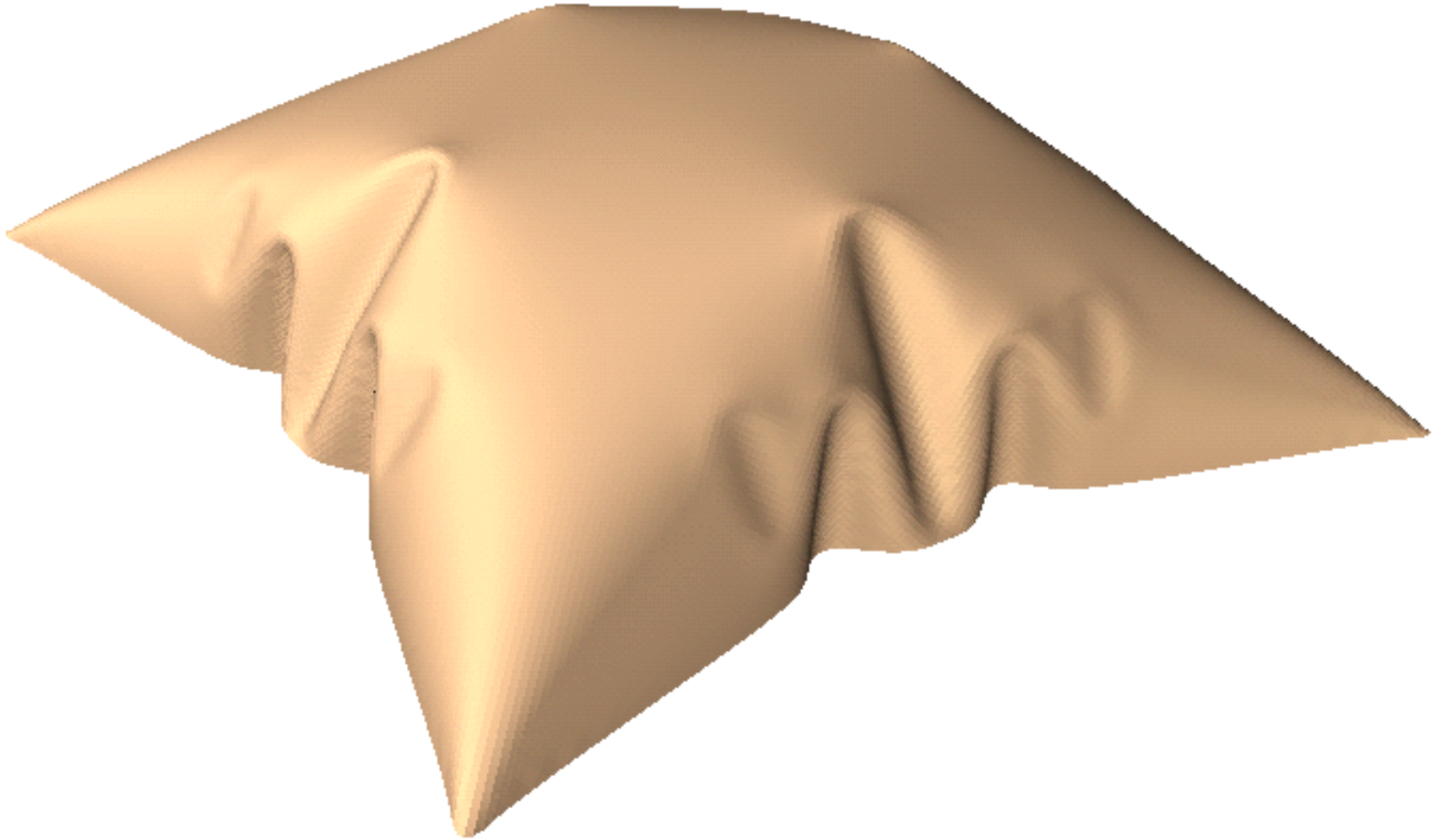
(Cirak and Ortiz, IJNME '00)

(Cirak, Ortiz and Schröder, IJNME '00)

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Shell finite elements - Square Airbag



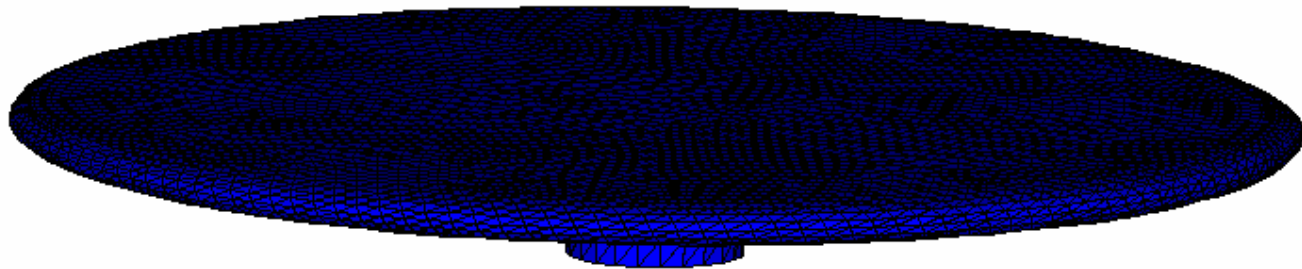
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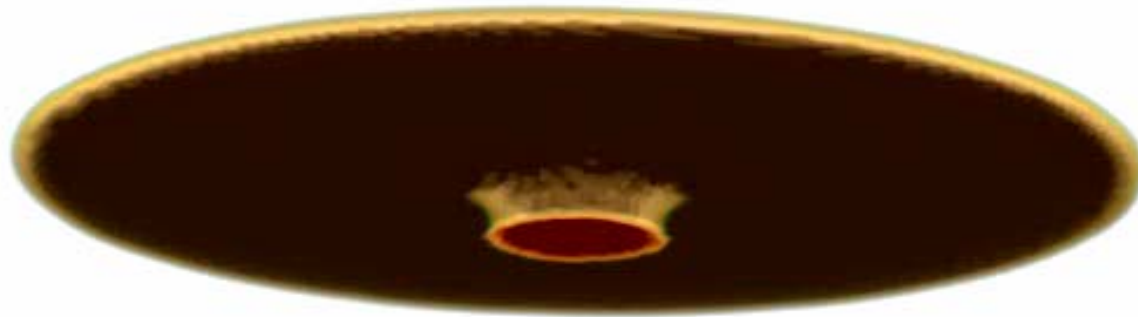


Airbag inflation - Bag (Cirak *et al.* '03)



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Airbag inflation - Gas (Cirak *et al.* '03)



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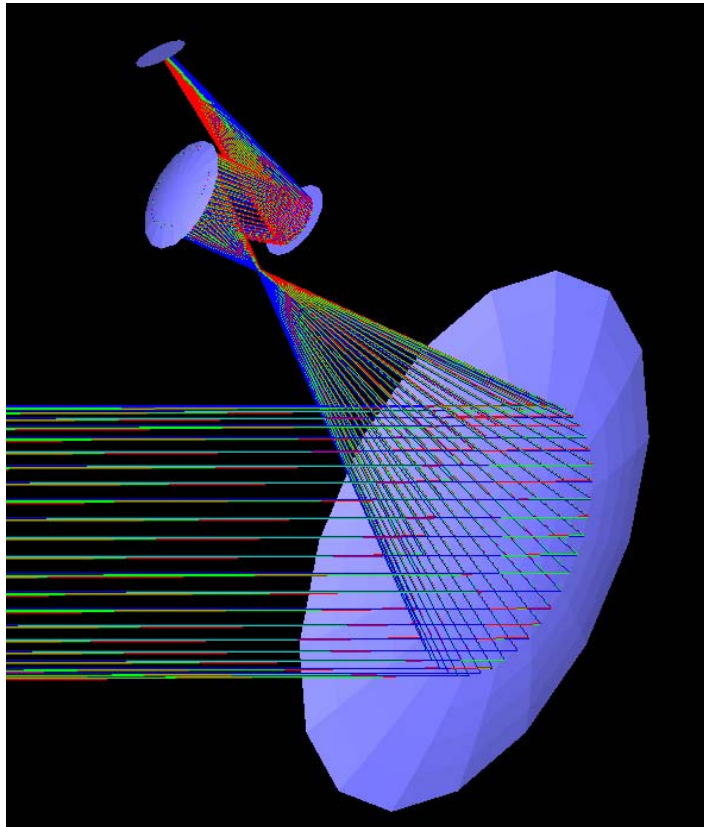
Shell fracture under impact – Petalling



(Cirak, Pandolfi and Ortiz '03)

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Membrane telescope systems (with JPL)



Telescope architecture
(M. Dragovan, JPL)



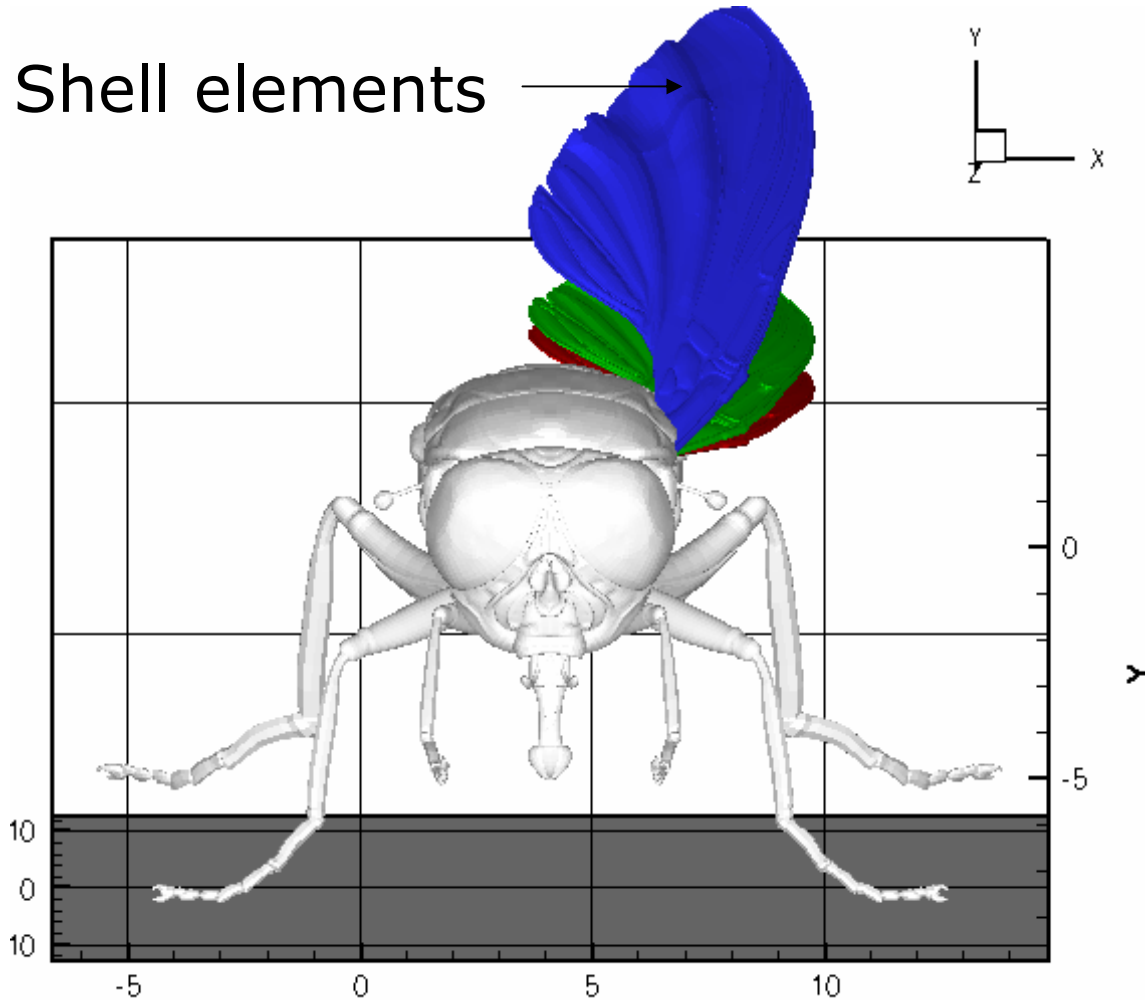
Rigidized polymeric thin membrane
(M. Dragovan, JPL)



Ultralight large-aperture telescope concept

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Insect flight (with M. Dickinson)



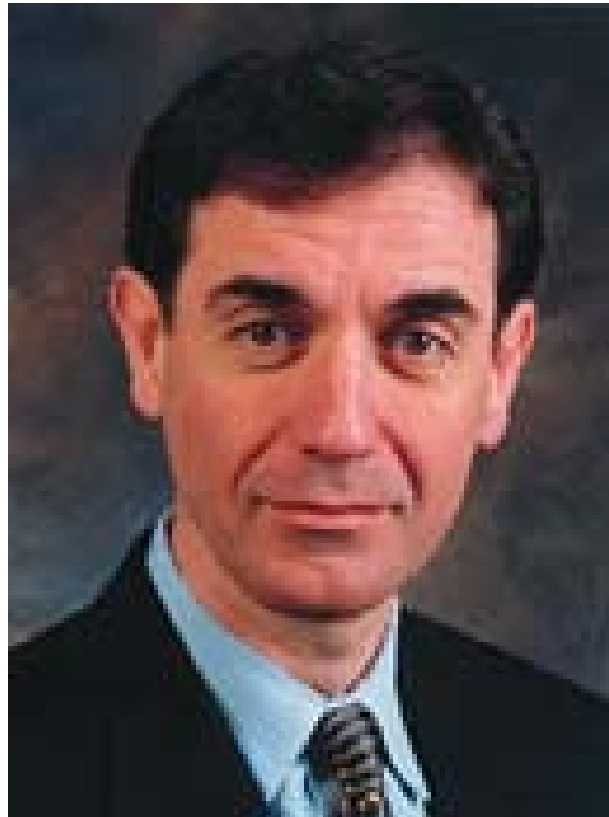
Computational model of fly
(Arienti and Ortiz 03)

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