Oresat Canted Turnstile Antenna Deployment

Design Documentation

Team Members:
Paijanne Jones, John George

Project Sponsor: Portland State Aerospace Society (PSAS)
May 26, 2018

Executive Summary:

Project Objective Statement:

-include constraints

Design Concepts:

-Elfin

-3d printed mount

-Fiberglass tape springs embedded wires(tape measure steel springs for model)

-GOM

-Torsion springs

-3d printed hinge

-tape measure steel springs

-C1008 spring steel ribbon

-Three designs

-Burnwires

-Three thicknesses and strengths of nylon filament (fishing line)

-Small resistors and Nichrome Wire

-Thorough testing(reference document)

Design Requirements Update:

-major design change from sponsor requiring 4 wires per pole. Copper inlay on .15mm FR4. (10mm width of strip)

-increased space budget from 6.5mm to 17mm vertically but lost space in the horizontal plane due to solar panel connectors.

-required nonconductive deployment mechanism

-required update from conductive steel tape spring to non-conductive fiberglass

Final Design and Results:

-Deployment structure

-Increase in mount footprint by roughly 50%

-Considerations for mounting deployment structure to Oresat end card

-Tape Springs

-Considerations for mounting tape springs to deployment structure

-Doubled in size (10mm to 20mm)

-bistability stresses

-Material selection

-Fiberglass manufacturing

-FR4 integration

-Burn Wires

-Explain results of ME411 paper

-Explain conceptual design for burn wire integration into deployment Structure

Future Work:

-Deployment structure

-Final design and machining

-Tape Springs

-Final material selection and testing

-Stronger Vacuum

-FR4 integration

-Burn Wires

-final burn wire integration into design

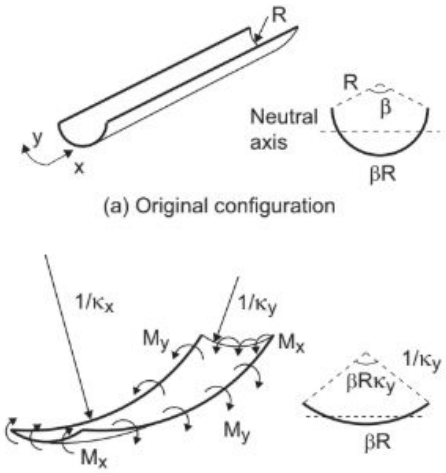

Figure 2.2: Bending and geometry definition (courtesy of Iqbal & Pellegrino), [12].

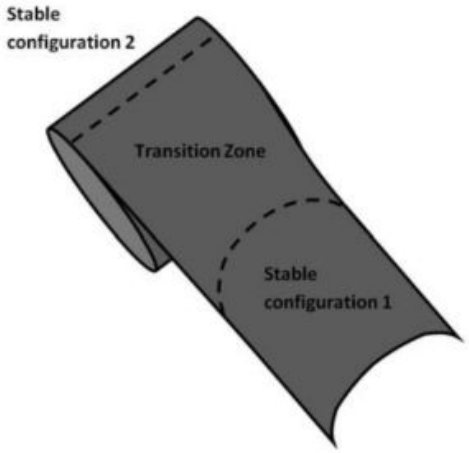

Figure 2.1: The three zones of the tape spring during deployment (courtesy of Yoann Prigent), [11].

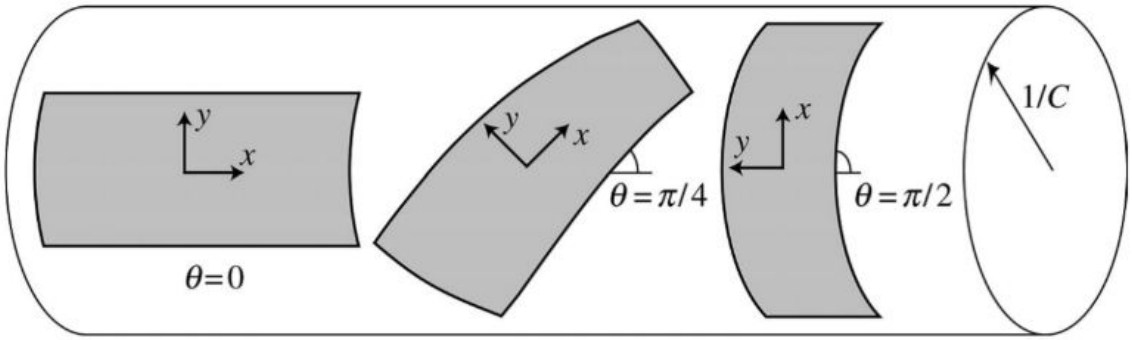

Figure 2.6: Coordinate system where shells are on an underlying cylinder of radius 1/C, [13].

7781 prepreg material properties

Specific Product Properties	
Style	7781
Finish	627
Weave Pattern	8 HS
Yarn Description	Warp: ECDE 75 1/0
	Fill: ECDE 75 1/0
Count: Ends x Picks (in)	57 x 54
Weight	8.95 oz/yd^2
Breaking Strength (lb/in)	Warp: 350 lb/in
	Fill: 340 lb/in
Thickness	0.0090 in

Neat Resin Properties	
Density (g/cc)	1.21
Tg (°F/°C) (from G" DMA curve)	255 /124
Tensile Modulus (ksi/GPa)	410 / 2.8
Tensile Strength (ksi/MPa)	11.5 / 79.0
Elongation at Break (%)	4.5
Tg after 24-Hr Water-Boil (°F/°C)	169 / 76*
Water Absorpotion %	3.9*

Cure	
Target Temperature	Hold For
310°F (154°C)	1 Hour
290°F (143°C)	2 Hours
270°F (132°C)	4 Hours

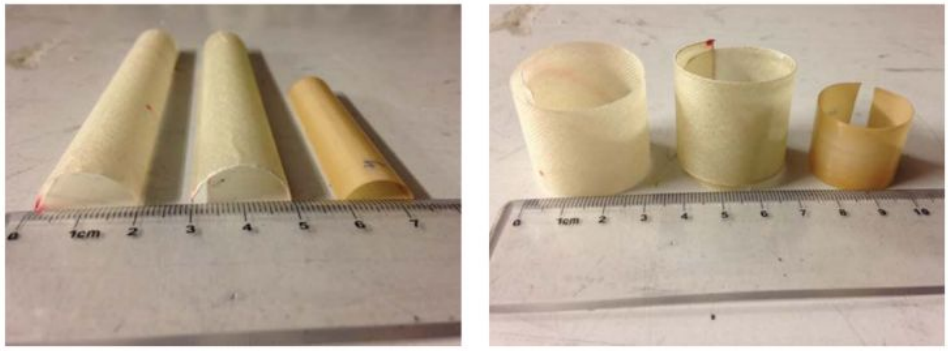

Figure 4.8: Made samples and AFRL tape spring.

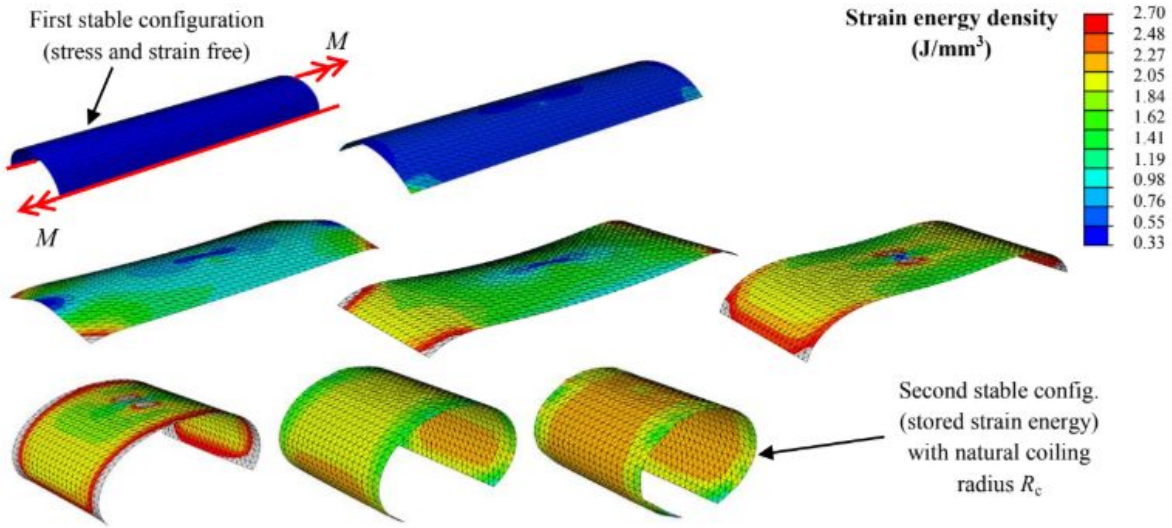

Figure 2. Transition of a bi-stable tape spring between the first stable configuration (straight) and the second one (coiled).

Table 1: *Boom requirements overview*

Parameter	Consequence	Comment
Stiffness		
Large stiffness	Low deflection	Good
Small stiffness	Low deployment speed	Good
Thickness		
Small thickness	Small volume	Good
Small thickness	Low stiffness	Good and bad
Small thickness	Low strength	Bad
Large thickness	Large volume	Bad
Large thickness	High stiffness	Good and bad
Large thickness	High strength	Good
Width		
Small width	Small volume	Good
Small width	Low stiffness	Good and bad
Small width	Low strength	Bad
Large width	Large volume	Bad
Large width	High stiffness	Good and bad
Large width	High strength	Good

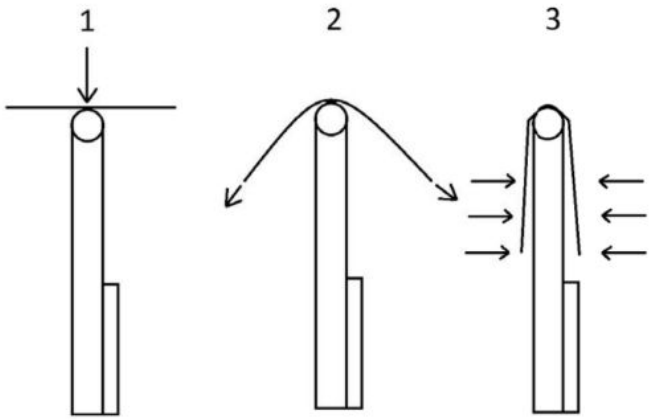

Figure 18: *Fiber layup on mold*