ARQUIMEA

Passion for Technology

Shape Memory Alloy Materials for Space and Aeronautics

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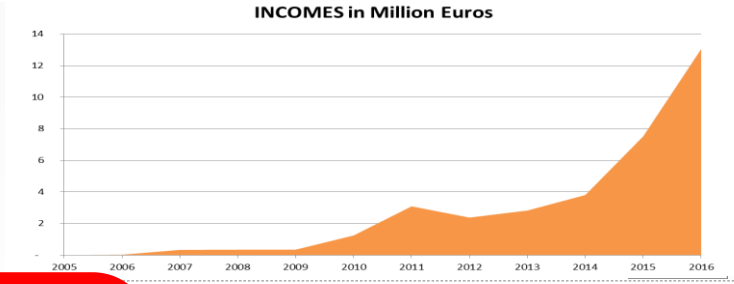
ARQUIMEA

Passion for Technology

ARQUIMEA
PASSION FOR TECHNOLOGY
GROUP®



Shareholder

Diego Fernández, PhD.

SME
- **13M€** revenues
- **2M€** EBITDA
- **100** employees

Headquarters

Madrid (ES)

Branches & Subsidiaries

Frankfurt Oder (DE)

Hong Kong (CN)

Havana (CU)

HI-REL COMPONENTS AEROSPACE, NUCLEAR	ONBOARD SYSTEMS DEFENCE & SECURITY	AIRPORT SERVICES	BIOTECHNOLOGY	VENTURE CAPITAL	HEALTH
					
ARQUIMEA	EXPACE	ARQUIMEA Airport Services	ZOITECH lab	KAUDAL TECHNOLOGY INVESTMENT	TERAS

Our Mission

to Deliver Useful Technology Everywhere

COMPANY OVERVIEW

Supplier of **Hi-Rel technologies** Strong **R&D** activity and **product-oriented** strategy

TECHNOLOGIES

- ELECTRONICS (ENGINEERING)
- SPACE MICROELECTRONICS
- MECHANISMS
- NUCLEAR WASTE DISPOSAL TECHNOLOGIES

PRODUCTS

- MICROELECTRONICS
- SPACE ACTUATORS

MEMBER OF

ASD-EUROSPACE
The Space group in ASD

SME4SPACE

BBAA
Berlin-Brandenburg Aerospace Allianz e.V.

tedae
Asociación Española de Empresas Tecnológicas de Defensa, Aeronáutica y Espacio

enterprise europe network

MAIN COSTUMERS & PARTNERS

esa

ThalesAlenia Space

AIRBUS DEFENCE & SPACE

ANDRA
Agence nationale pour la gestion des déchets radioactifs

TTTech

OHB

STI

SOFICS
SOLUTIONS FOR ICS

SURREY
SATELLITE TECHNOLOGY LTD

DLR Robotik und Mechatronik Zentrum

SENER

SENSITRON SEMICONDUCTOR

INTA

European Commission

ihp

KONGSBERG

IRSN
INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE

Mier
COMUNICACIONES

CSIC

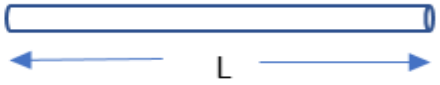
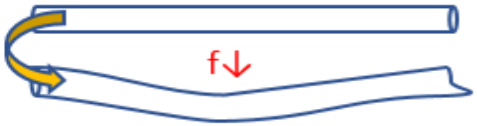
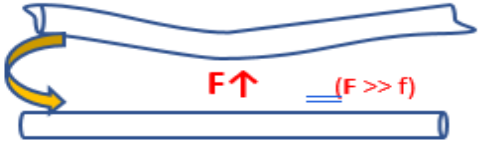
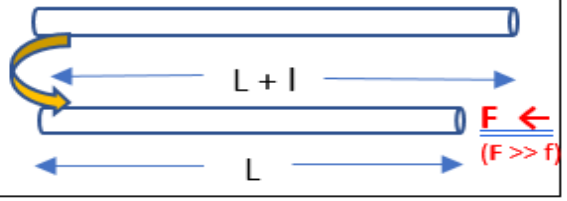
SHAPE MEMORY ALLOYS

Shape Memory alloys are metallic materials can remember their form and return to its form after deformation, depending on the temperature nad mechanical stress, with two main effects:

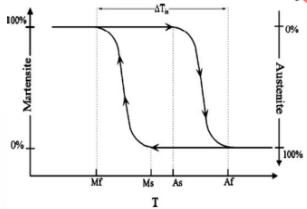
- Shape Memory
- Superelasticity.

SHAPE MEMORY ALLOYS

Shape Memory effect

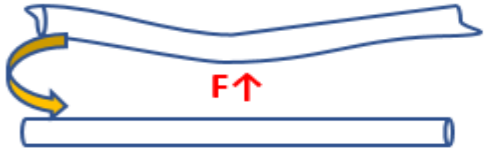
Step	Temperature changes*	Material phase	Example 1 (lateral deformation)	Example 2 (longitudinal deformation)
1	High (> Tf)	Austenite	Original form. The material opposes to be deformed 	Original length. The material opposes to be stretched 
2	Low (<Tf)	Martensite	The material can be easily deformed 	The material can be easily stretched 
3	High (>Tf)	Austenite	The material returns to its original form an opposes to be deformed 	The material returns to its original length an opposes to be stretched 

*There is a hysteresis factor to be considered (Tf As→Ma < Tf Ma-> Au)



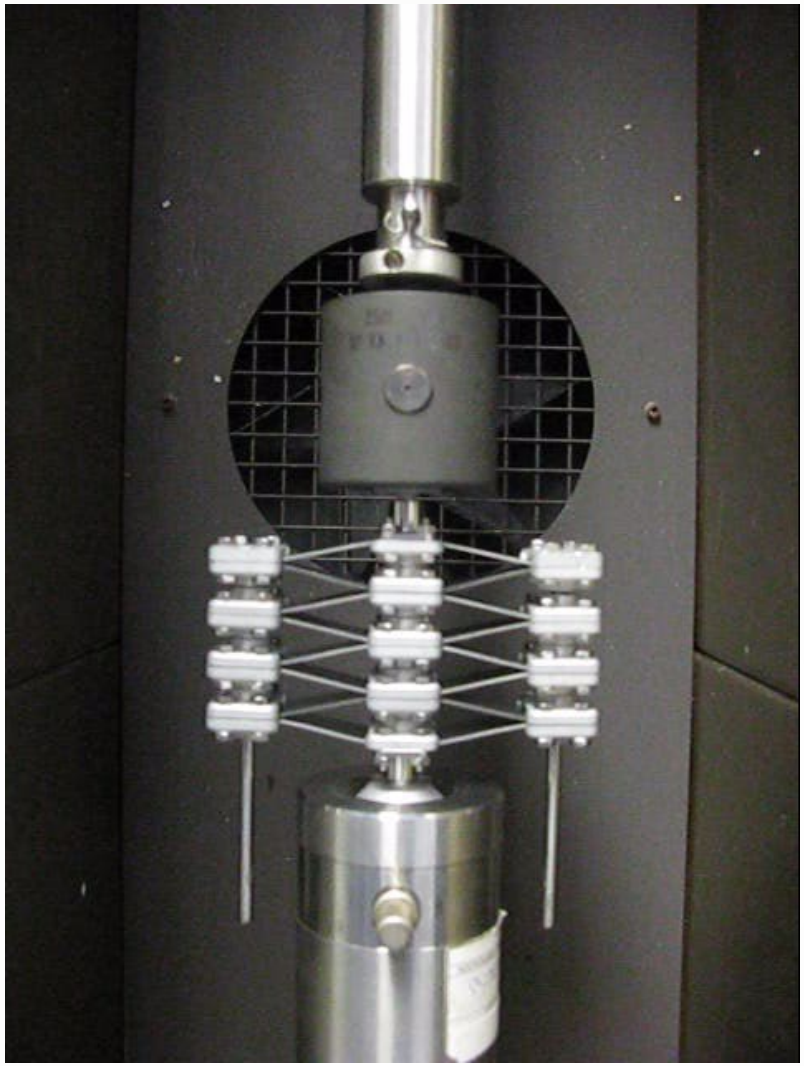
SHAPE MEMORY ALLOYS

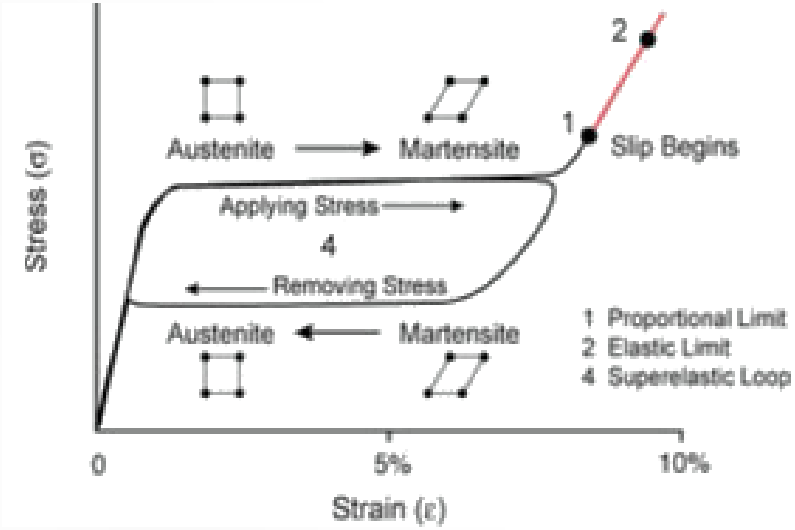
Superelasticity

Step	**Mechanical stress**	Material phase	Example 1 (lateral deformation)
1	**No Mechanical stress**	Austenite	Original form. The material opposes to be deformed 
2	**Mechanical stress**	Martensite	The material is deformed by a mechanical stress 
3	**Stop mechanical stress**	Austenite	The material returns to its original form 

SHAPE MEMORY ALLOYS

Superelasticity

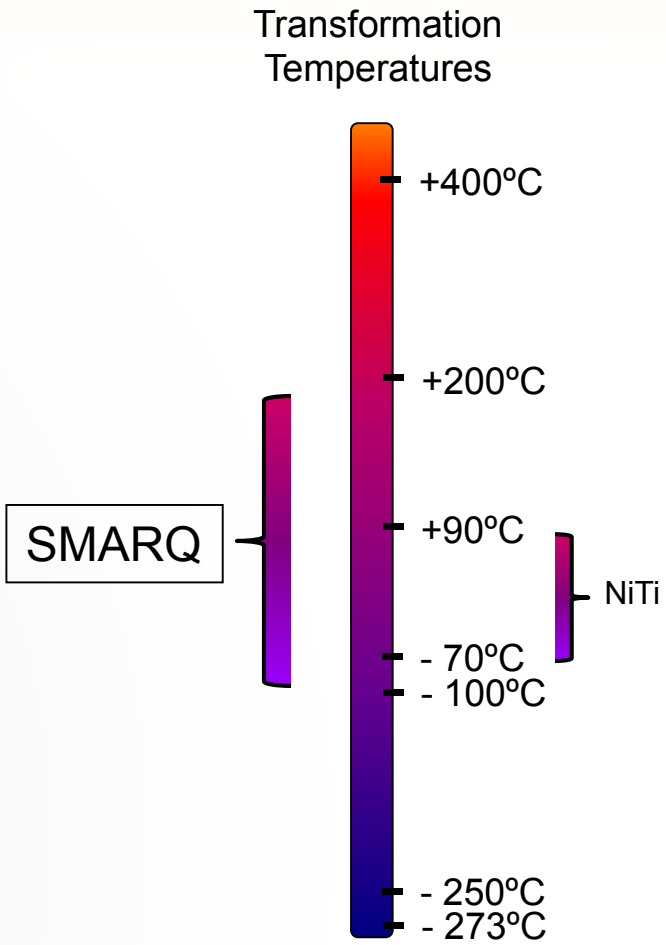




SHAPE MEMORY ALLOYS

ARQUIMEA'S HIGH TEMP SMA (SMARQ)

- Innovation: SMARQ
  - Novel SMA material:
    - Extended operation temperature range (up to 180ºC).
    - Proprietary technology and production processes.
      - Rods
      - Plates
      - Fibers (from 10um up to any size)
      - Fancy geometries



SHAPE MEMORY ALLOYS
SPACE APPLICATIONS

ROTARY ACTUATORS

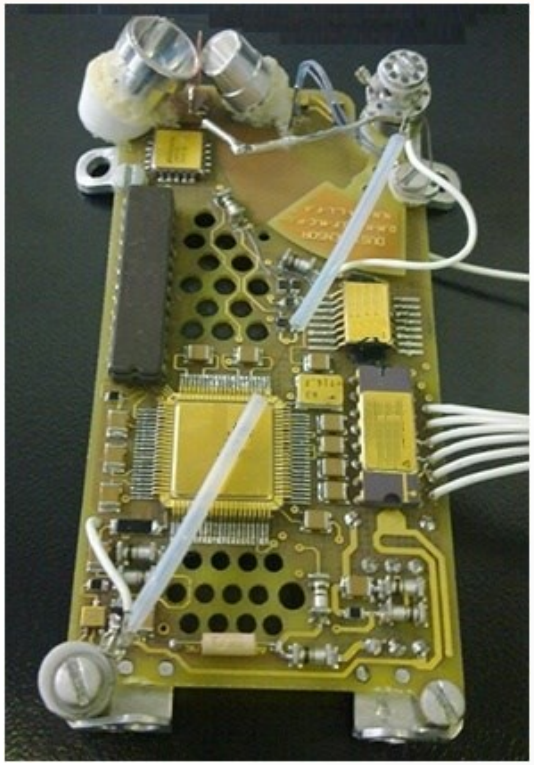
PIN PULLERS

HDRM

PROPULSION VALVES

SMART STRUCTURES FOR DEPLOYMENT

SPACE APPLICATIONS

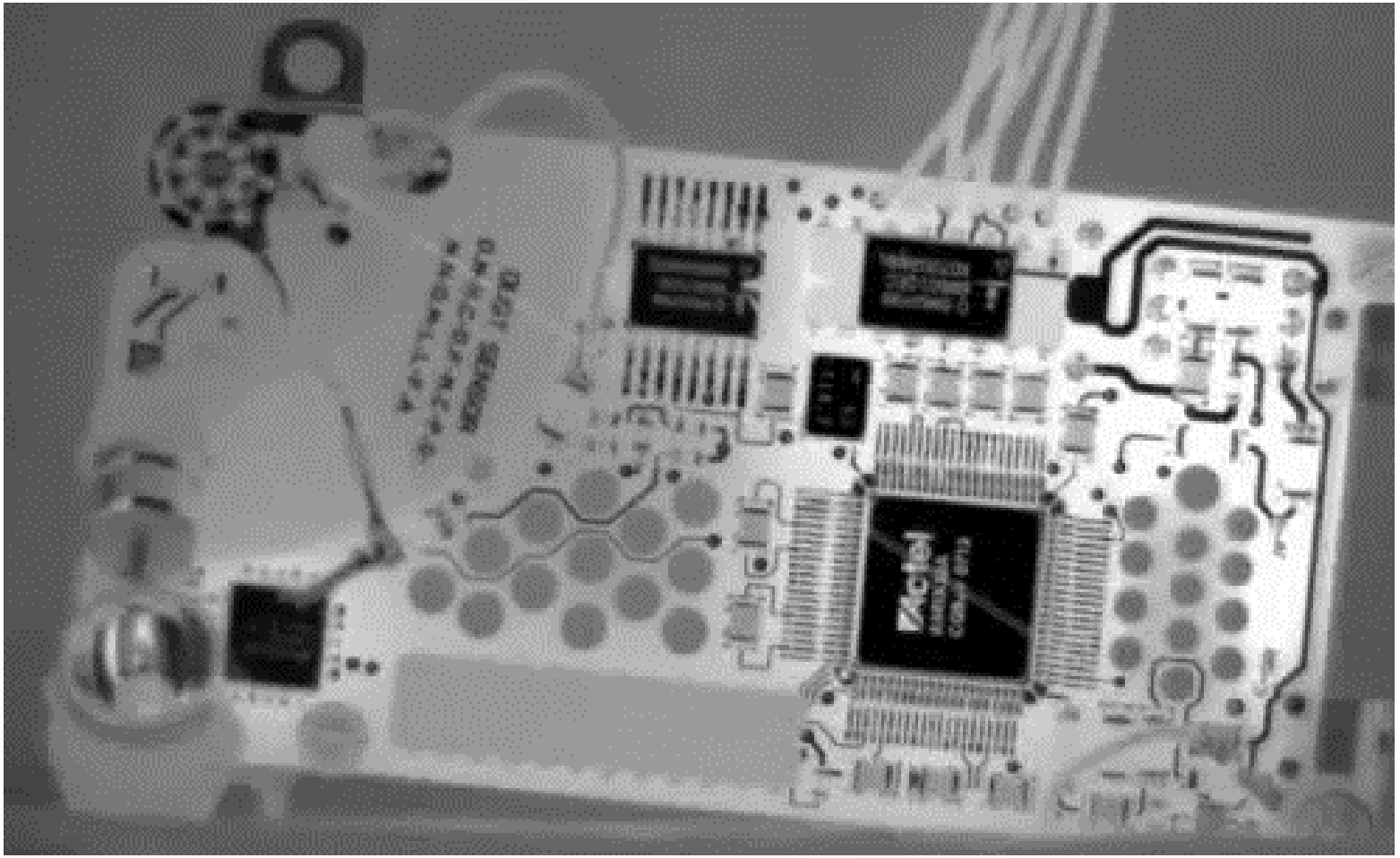


Qualified for Mars mission

ROTARY ACTUATORS

SPACE APPLICATIONS

Rotary actuators



SPACE APPLICATIONS

Rotary actuators

SPACE APPLICATIONS

EM to TRL6
Redesign ongoing
FM in 2019

PIN PULLER

One shot

Non-explosive

Low shock

Fully resettable by user

SPACE APPLICATIONS

Pin puller

SPACE APPLICATIONS

Space qualified
FMs delivered

HDRM (REACT)

One shot

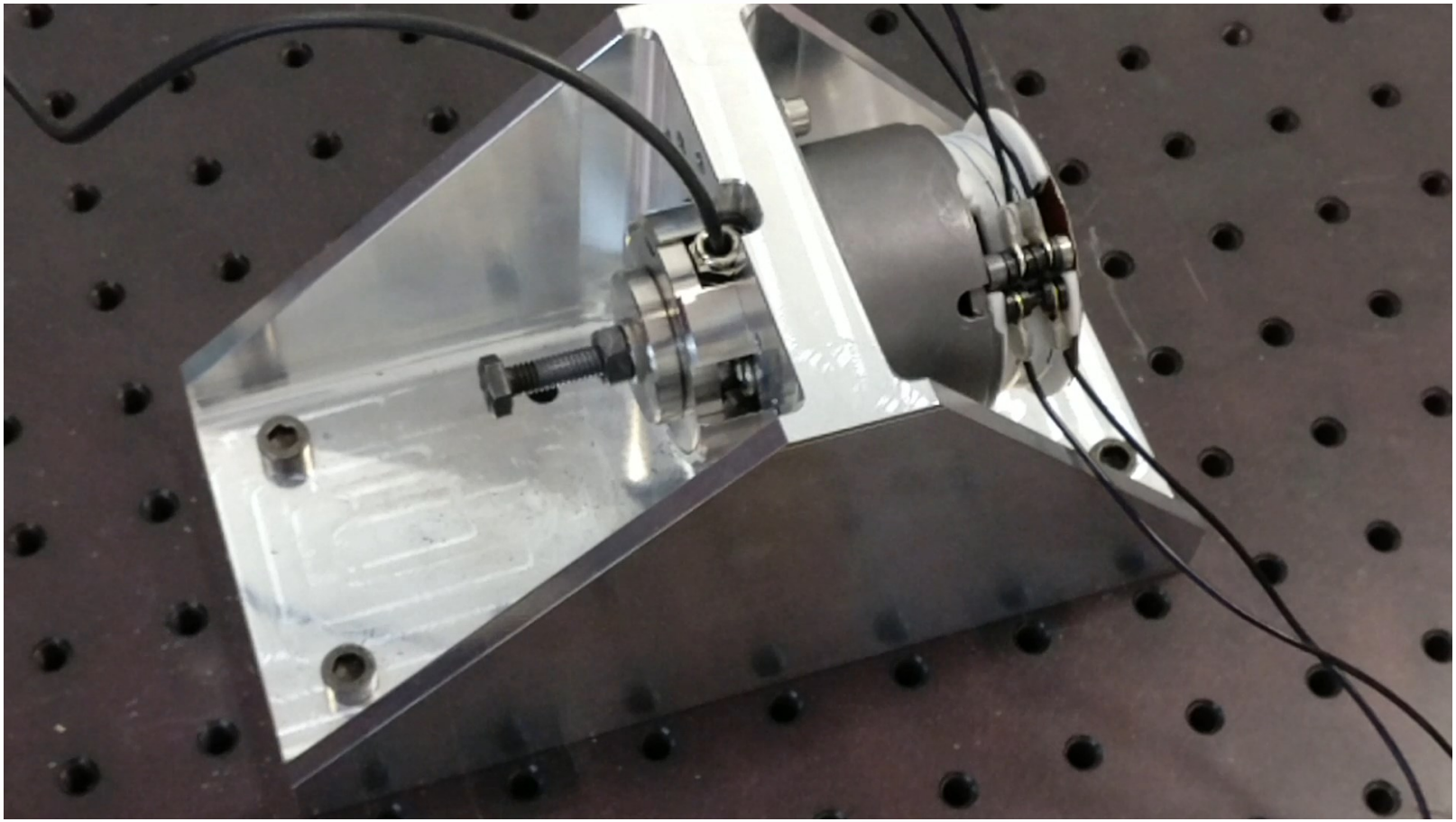
Non-explosive

Low shock

Fully resettable by user

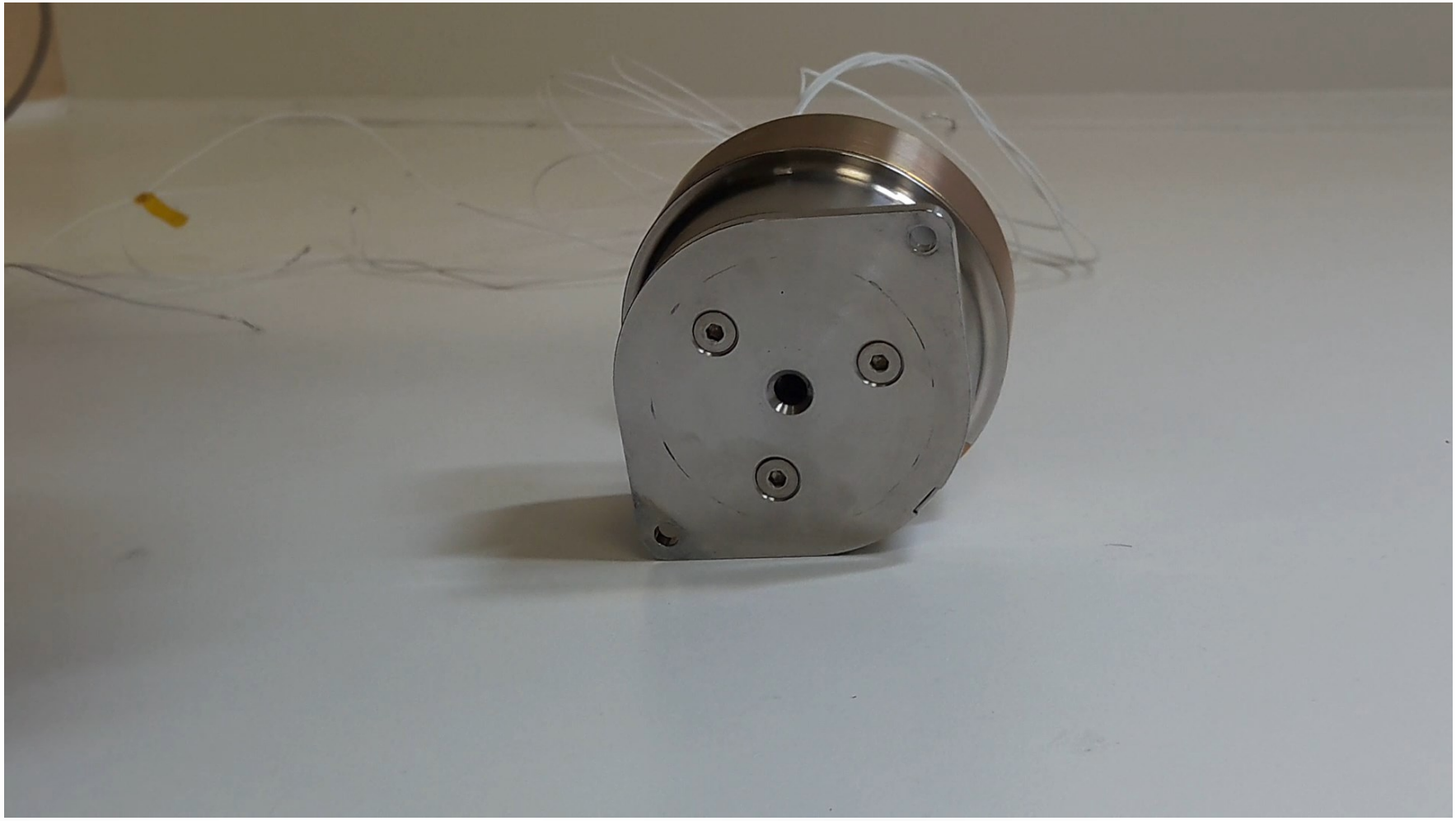
SPACE APPLICATIONS

HDRM (REACT)



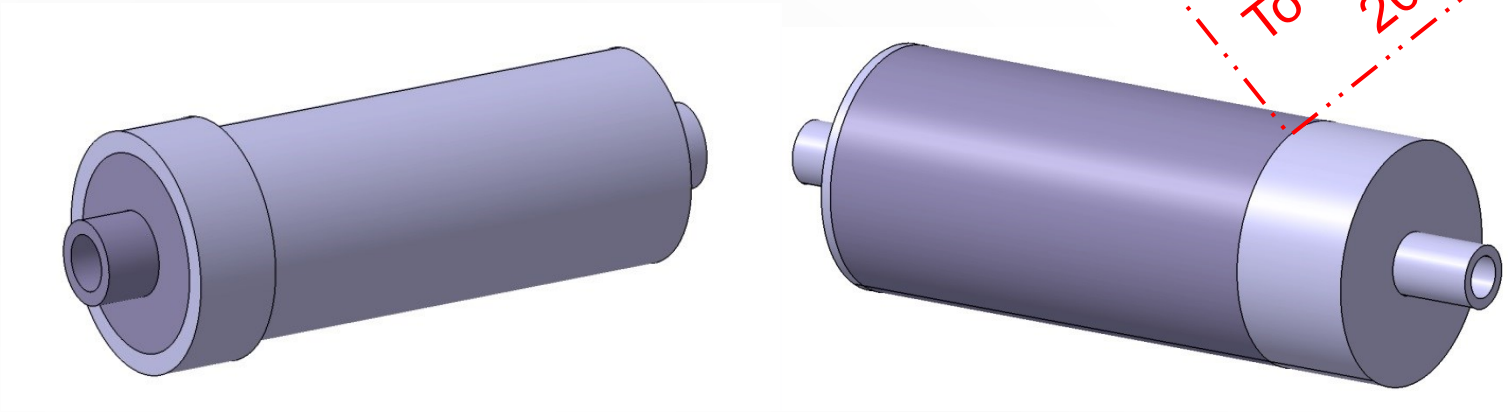
SPACE APPLICATIONS

HDRM (REACT)



SPACE APPLICATIONS

Concept
To be developed in
2018-2020



PROPULSION VALVES

Non-explosive

Simple, compact design

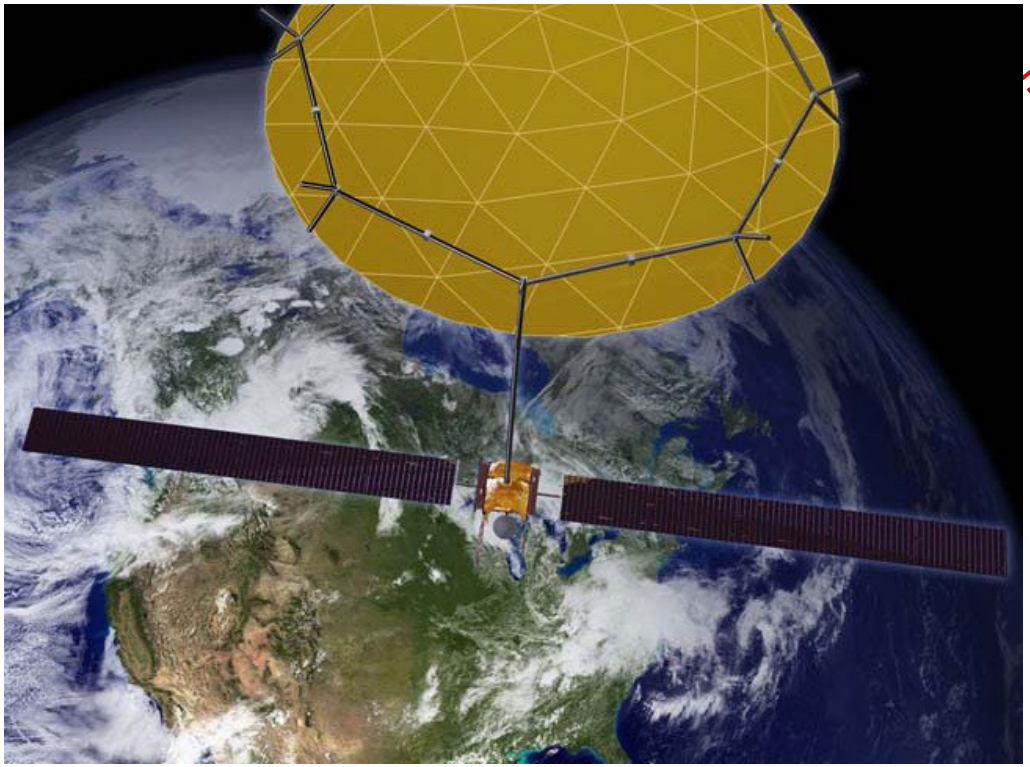
In-line configuration

Lightweight

Low volume

SPACE APPLICATIONS

Potential applications



INTELIGENT STRUCTURES FOR DEPLOYMENT (COMPLIANT MECHANISMS)

AERONAUTICS APPLICATIONS

Variable geometry structures and morphing for noise reduction and fuel savings:

Chevron

*

Fan Nozzles

Adaptable Wings

http://www.materialsforengineering.co.uk/engineering-materials-features/shape-memory-alloy-allows-for-foldable-wings-without-actuators/170550/

Rotor Blades

Shock absorbers

https://www.slideshare.net/MohammadTanhaei/sma-41292540
https://www.sciencedirect.com/science/article/pii/S0921509306008227
*https://www.grc.nasa.gov/WWW/StructuresMaterials/AdvMet/research/shape_memory.html

AERONAUTICS APPLICATIONS

Shape memory alloy allows for foldable wings without actuators

Nasa has successfully applied a new technology in flight that allows aircraft to fold their wings to different angles while in the air.

The recent flight series, which took place at Nasa's Armstrong Flight Research Center in California, was part of the Spanwise Adaptive Wing project, or SAW. This project aims to validate the use of a cutting-edge, lightweight material that is able to fold the outer portions of aircraft wings and their control surfaces to optimal angles in flight.

SAW, which is a joint effort between Armstrong, Nasa's Glenn Research Center in Cleveland, Langley Research Center in Virginia, Boeing Research and Technology in St Louis and Seattle, and Area-I in Georgia, may produce multiple in-flight benefits to aircraft in the future, both subsonic and supersonic.

Folding wings in flight is an innovation that had been studied using aircraft in the past, including the North American XB-70 Valkyrie in the 1960s. However, the ability to fold wings in flight has always been dependent on heavy and bulky conventional motors and hydraulic systems, which can be cumbersome to the aircraft.

The SAW project intends to obtain a wide spectrum of aerodynamic benefits in flight by folding wings through the use of an innovative, lightweight material called shape memory alloy. This material is built into an actuator on the aircraft, which plays a vital role for moving parts on the airplane, where it has the ability to fold the outer portion of an aircraft's wings in flight without the strain of a heavy hydraulic system. Systems with this technology may weigh up to 80% less than traditional systems.

The recent series of flight tests at Armstrong successfully demonstrated the material's application and use, by folding the wings between 0 and 70° up and down in flight.

Many thanks!!

Questions?

Passion for Technology