FY17 GRC: Highly Compliant NiTi Spring Tires for a Martian Environment

Completed Technology Project (2017 - 2017)

Project Introduction

The leading concept for a Mars Sample Return (MSR) mission is to land a large rover on the surface of Mars capable of traversing the terrain, collecting samples of regolith left by the Mars 2020 (M2020) rover, and launching the sample cache back into orbit. A rover with these capabilities is estimated to have a mass on the order of 1600 kg, much heavier than any previous Mars rover. Hence, tires for this rover must support normal loads of 1600 N (350 lbs) while generating sufficient traction to traverse challenging terrain. The tires must also be resistant to damage from rocks, often at point loads reaching nearly 3200 N (700 lbs). In addition, the tires must be able to meet all of these requirements at Martian surface temperatures ranging from -130 to 90° C. The current state of Space tire technology does not meet these requirements. The primary goal of this effort was to demonstrate the high performance and durability of the new compliant NiTi Spring Tires at Martian surface temperatures.

Anticipated Benefits

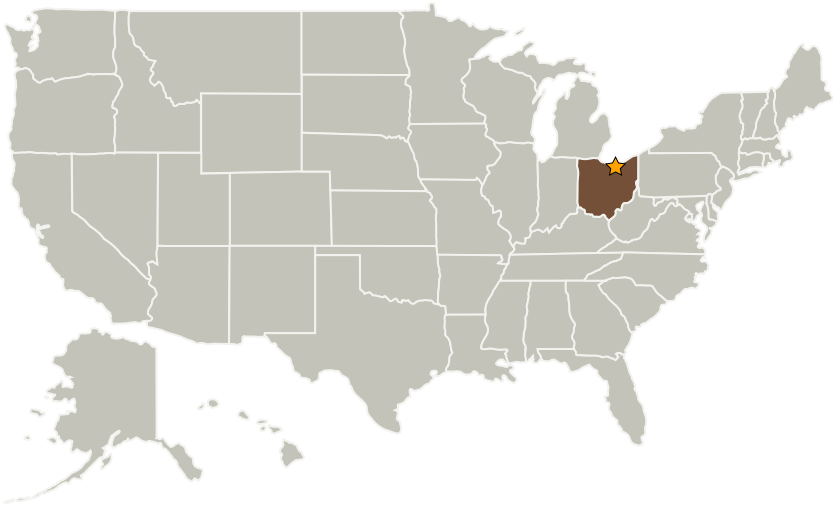
The near-term focus (5-10 years) is to enable the MSR mission. A highly compliant tire will allow the rover to traverse difficult terrain with a very low risk of entrapment or failure. This not only allows the rover to explore areas of scientific interest that were previously deemed too risky, but also reduces the time and energy spent both circumventing dangerous terrain and assessing every driving maneuver. This tire technology has substantial benefits in the long-term (10-20 years) for both Earth and in Space. A crewed exploration vehicle on either the Moon or Mars is likely to be very heavy and will most likely require driving speeds much greater than what is used for the Mars rovers. This means that the tires must be able to absorb impacts without taking damage or reducing vehicle speed. On Earth, pneumatic tires suffer from two major issues: 1) the loss of driving efficiency due to changes in air pressure, and 2) the high likelihood of a flat tire due to puncture. The NiTi Spring Tire could potentially replace traditional tires in certain applications and solve both of these problems.

FY17 GRC: Highly Compliant NiTi Spring Tires for a Martian Environment

Table of Contents

Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	2
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	3
Technology Areas	3
Target Destinations	3
Supported Mission Type	3

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
California Institute of Technology(CalTech)	Supporting Organization	Academia	Pasadena, California

Primary U.S. Work Locations
Ohio

Project Transitions

May 2017: Project Start

November 2017: Closed out

Closeout Summary: GRC considers this technology to be ready for adoption within the [HEOMD or SMD] surface exploration program/project portfolio. The GRC Space Flight Systems Directorate will support the accomplishment of this objective.

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Center Independent Research & Development: GRC IRAD

Project Management

Program Manager:

Gary A Horsham

Project Manager:

Colin M Creager

Principal Investigator:

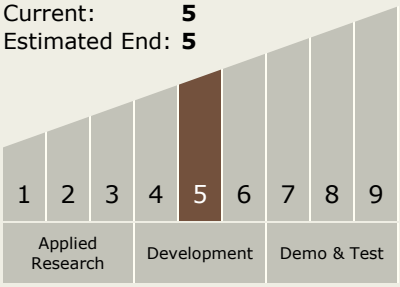
Colin M Creager

Co-Investigators:

Santo A Padula
Vivake M Asnani
Kyle A Johnson

Technology Maturity (TRL)

Start: **5**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX04 Robotic Systems
  └ TX04.2 Mobility
    └ TX04.2.2 Above-Surface Mobility

Target Destinations

The Moon, Mars

Supported Mission Type

Planned Mission (Pull)