

# Animal Locomotion on Granular Media

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How do we study the physics of animal locomotion and develop bio-inspired all-terrain robots?

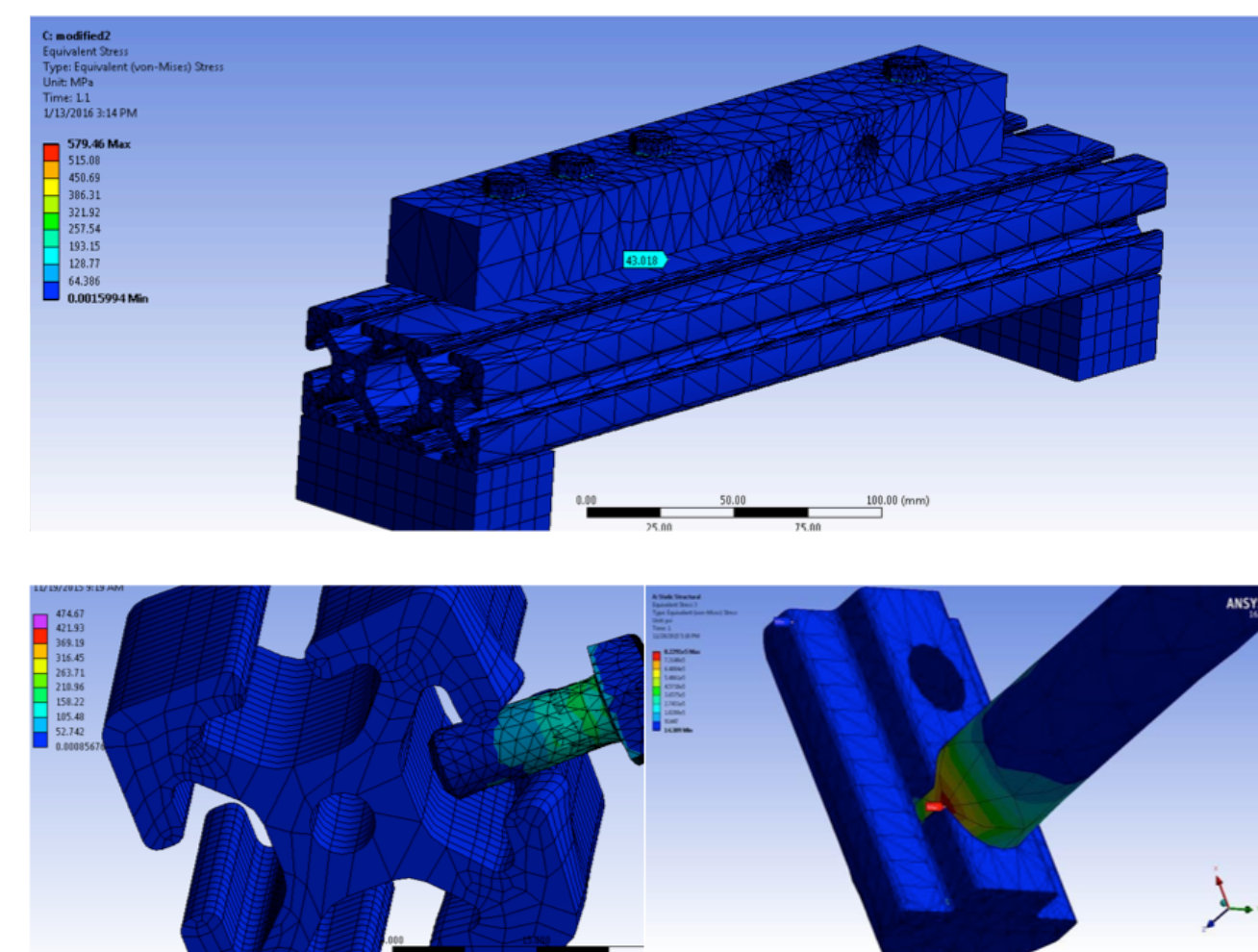
## INTRODUCTION

All around us there are very skilled animals and insects that can effectively move across a wide scope of materials from solid rock to deformable materials like sand, debris, and even on the surface of water. While our society's wheeled systems perform exceptionally on solid environments such as pavement, when the environment is changed to deformable surfaces, the performance decreases drastically. The problem with modern robots is that they are designed for only one specific surface not multiple granular surfaces.

## METHODS

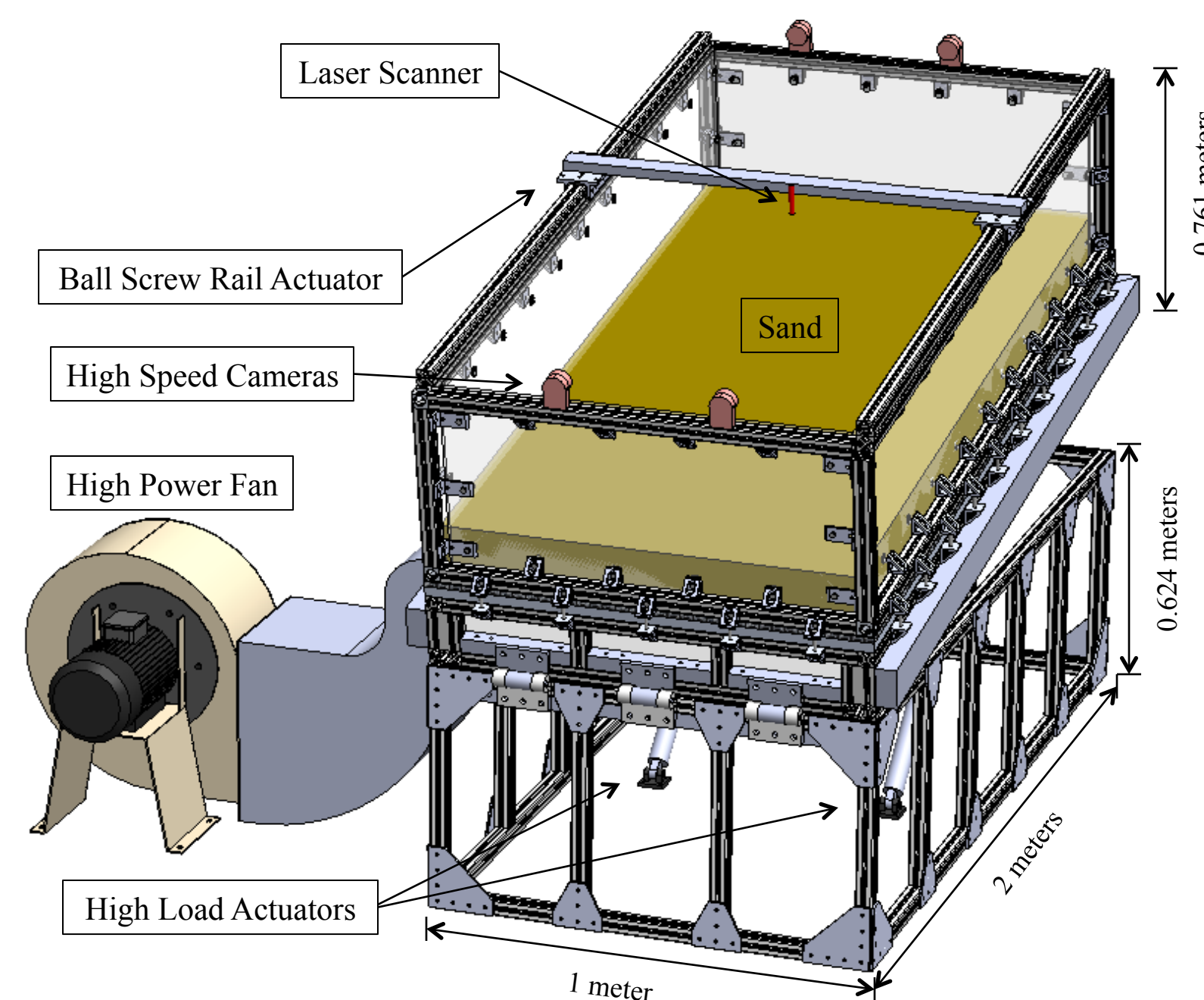
- Fluidize granular media in fluidized bed with high power fan
- Record images of specimen's motion
- Analyze the images for motion patterns
- Use laser scanner to scan the surface for shape and depth of specimen's foot
- Mount a 3D printed foot of the specimen on high speed actuator with force sensors
- Drag across the granular media for drag force
- Repeat for different desired angles

## FE ANALYSIS



The finite element analysis for the hinge system.

## FLUIDIZED BED



## ANIMAL EXPERIMENTS



Wahneema Lubiano, Long-nosed Leopard Lizard. Digital image. N.p. n.d. Web. 1 Apr. 2016.

## FEATURES

- Laser scanner to scan the surface of the granular media
- High load actuators to tilt the system at different angles
- High speed cameras to record the animals movements
- Drag force sensor to measure the force of the specimens foot
- High power fan to fluidize the deformable materials in the bed
- Ball screw rail actuators to control the scrapper for compacting the deformable materials

## CHALLENGES

- Dealing with dust (exhaust and filtration)
- High loads on the structure
- Full automation of the setup
- Scanning the surface
- High speed/high precision actuators
- Working with animals

## FUTURE WORK

- Developing robots for:
  - Search and rescue missions after natural disasters
  - Planetary exploration to find a place that has signs of life or contains valuable resources



A Natural Disaster



Mars Rover