Team 517
Sample On-Boarding and Orientation

November 7, 2019

Justin Bomwell

Victor Prado

Kalin Burnside

Ryan Dingman

Joshua Jones

Matthew Schrold

Department of Mechanical Engineering

FAMU-FSU Engineering

Senior Design Team 517

Justin Bomwell
Software Engineer

Victor Prado
Design Engineer

Kalin Burnside
Power Systems Engineer

Ryan Dingman
Controls Engineer

Joshua Jones
Robotics Engineer

Matthew Schrold
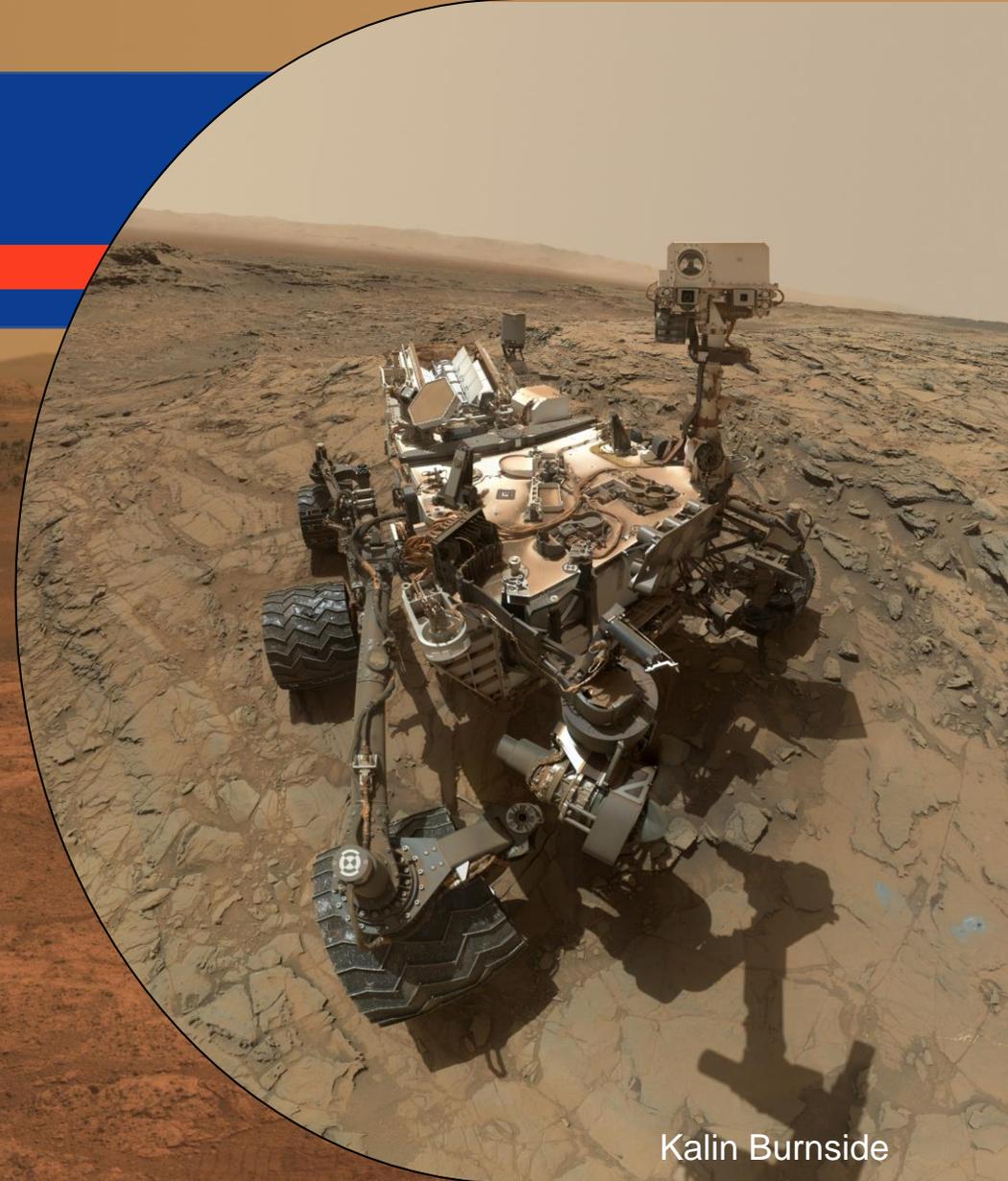Test Engineer

Angela Jackman
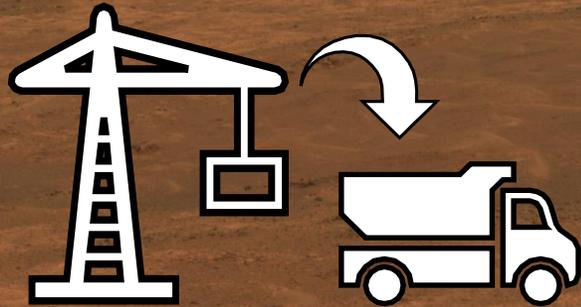Sponsor

Dr. Camilo Ordóñez
Advisor

Kalin Burnside

Objective

The objective of this project is to onboard a sample from the environment, then manipulate it within the rover so that testing instruments can perform all necessary tests on the sample.
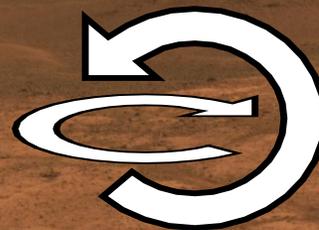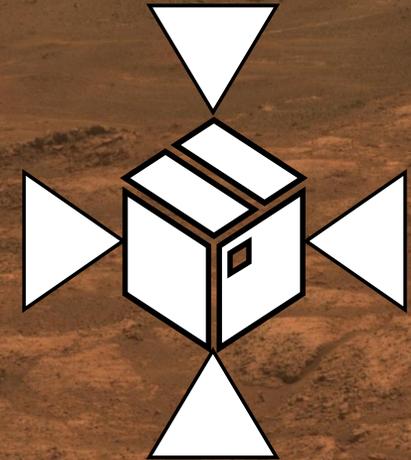
Kalin Burnside

Targets and Metrics
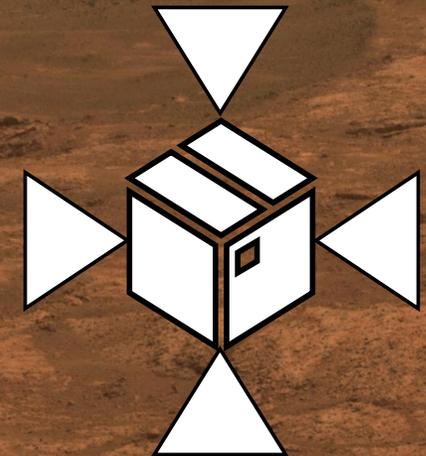
Onboard

Orient

Store

Kalin Burnside

Targets and Metrics

Onboard

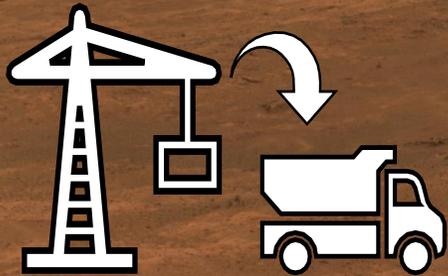| Function	Description	Target
Secure Sample	Hold weight	1 kg
Move Sample	Move samples that are this far away	50 cm
Position sample	Distance from goal point	1 cm

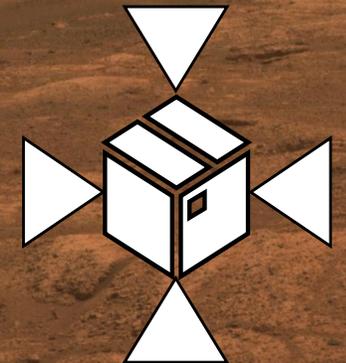Onboard

Orient

Store

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Targets and Metrics

Orient

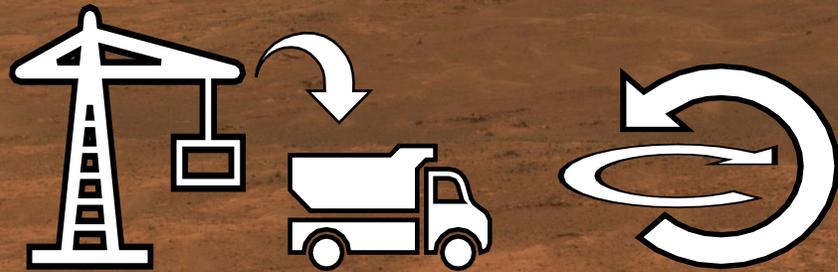| Function	Description	Target
Receive Sample from Onboard	Accept sample size (sample diameter)	7 cm
Stabilize Sample	Maximum translation rate	0 cm/sec
Stabilize Sample	Maximum rotation rate	0 deg/sec
Rotate Sample	About X and Y axes (rotation possible)	360 deg

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Targets and Metrics

Store

Function	Description	Target
Move Sample	Move % distance to storage	100%
Contain Sample	% of surface area exposed	0 %
Stabilize Sample	Maximum translation	0 cm
Stabilize Sample	Maximum rotation	0 deg

Onboard

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Store

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Validation Methods

Small 1 kg ball

Measure Distances

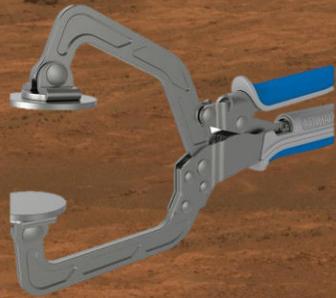Rotational Precision
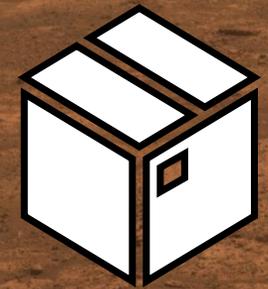
Completely Enclosed

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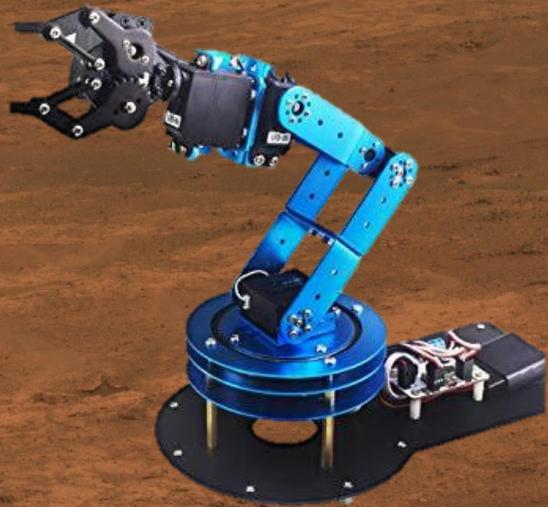# Concept Generation

Brainstorming

Biomimicry

Victor Prado
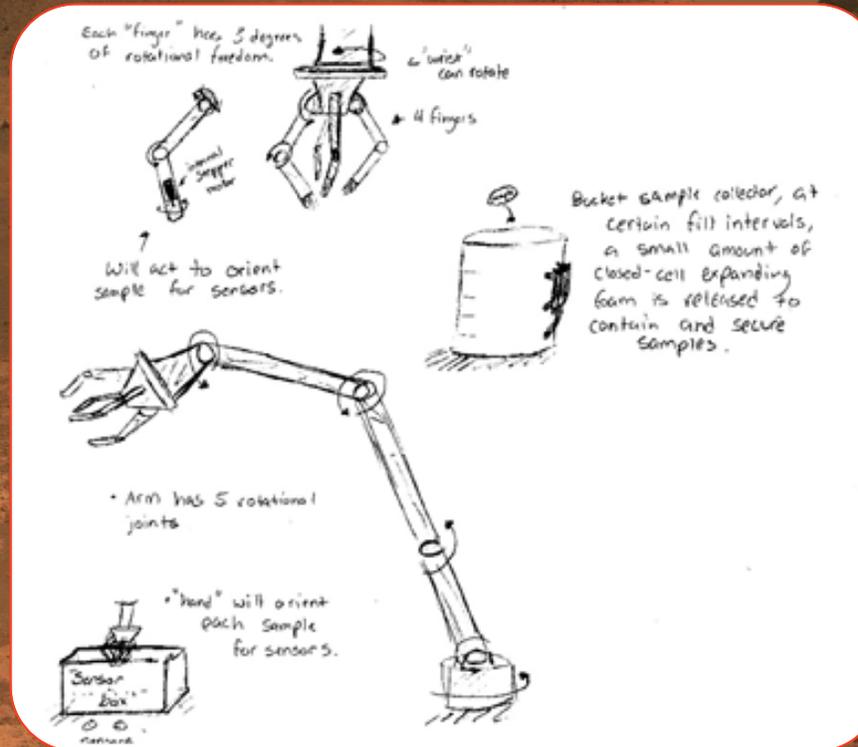
Concept Generation

Morphological Chart

Victor Prado

Spin Fingers

Advantages

- Combines onboarding and orientation to one system

- Sensors can be in multiple locations
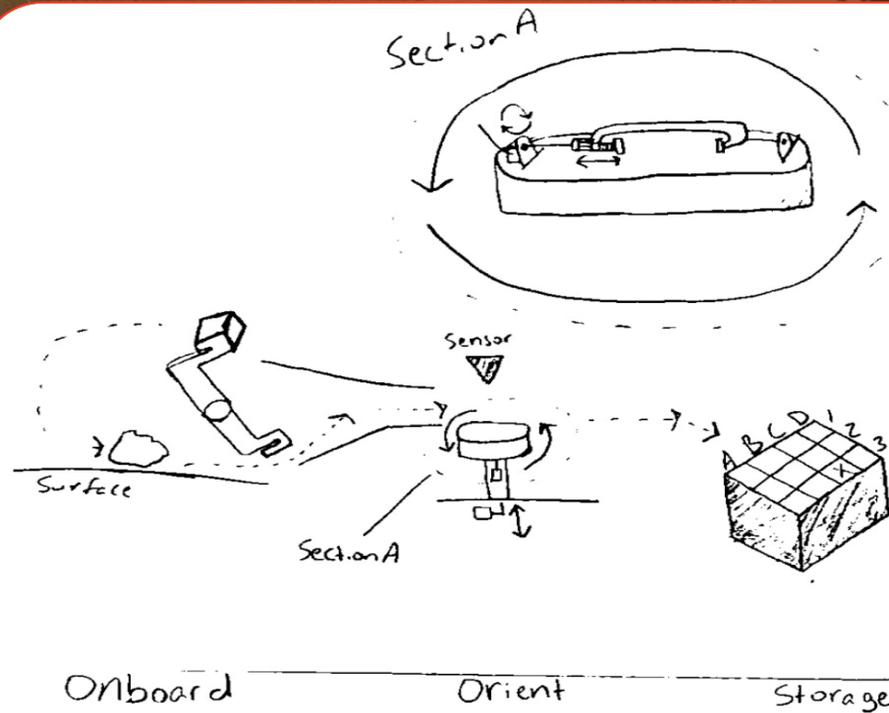
- Reduced Mass

Disadvantages

- Storage does not effectively stabilize samples

- Requires small, expensive motors in fingertips

Victor Prado

Rock Picker

Advantages

- Accepts wide sample size range

- Stabilizes samples in manipulator

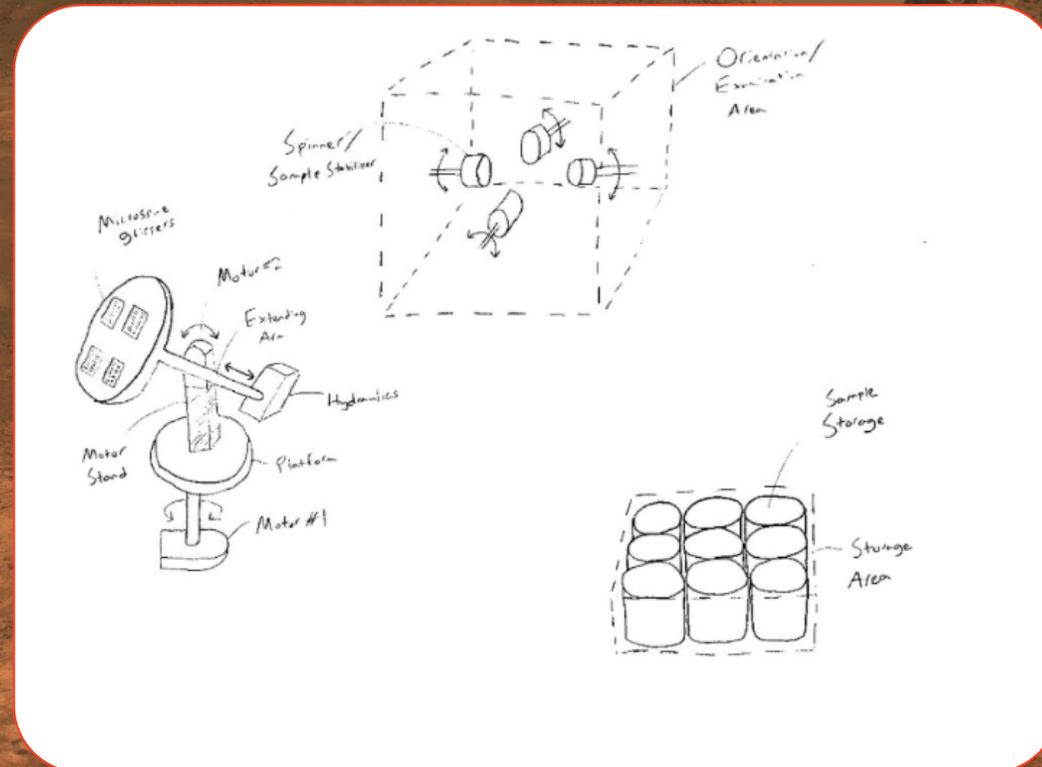- Storage is organized

Disadvantages

- Heavy

- Relatively lower positioning precision

- Clamp may block sensors

Victor Prado

Microspine

Advantages

- End effector strongly secures sample during collection
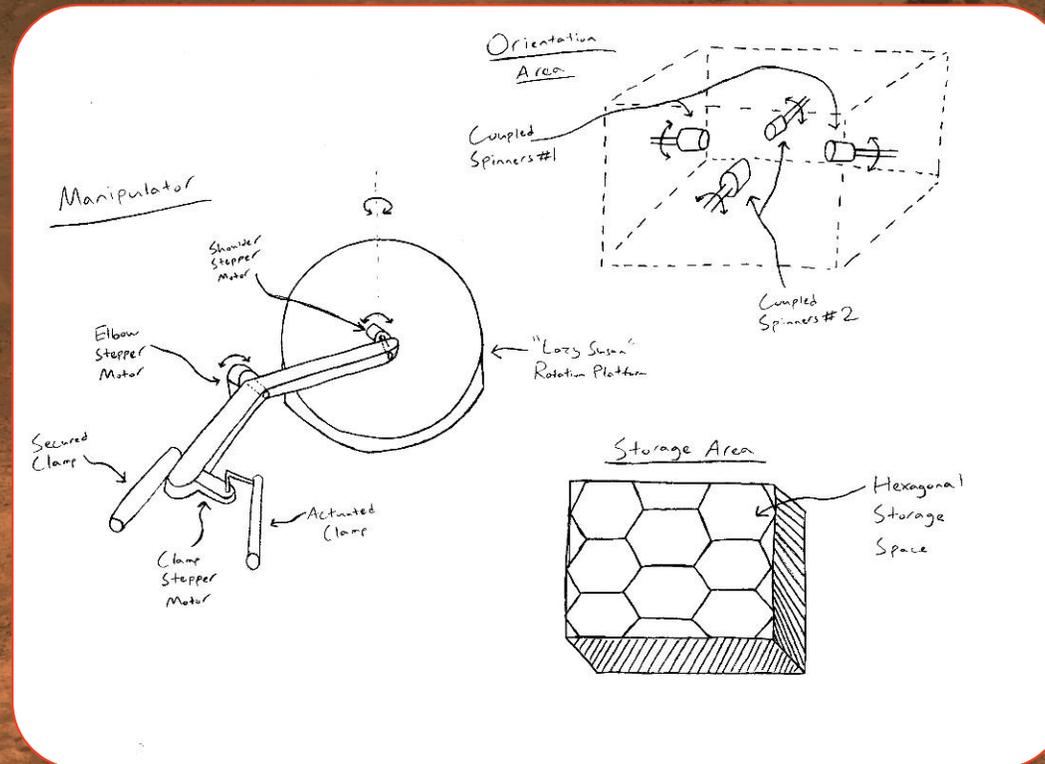
- Accepts wide sample size range

Disadvantages

- Requires large surface area of microspine grippers

- End effector induces a large moment on the motor

Victor Prado

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Clamp Arm

Advantages

- Ample precision in orientation area
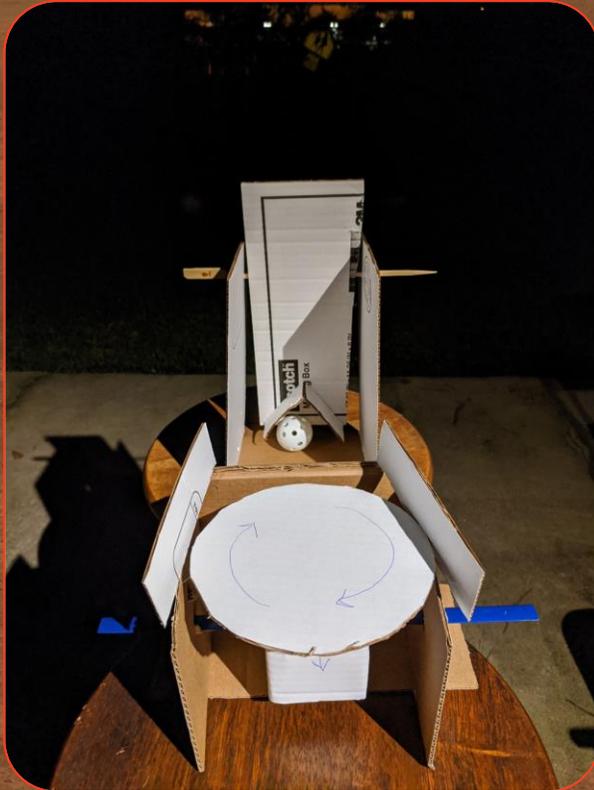
- Storage has high packing factor

Disadvantages

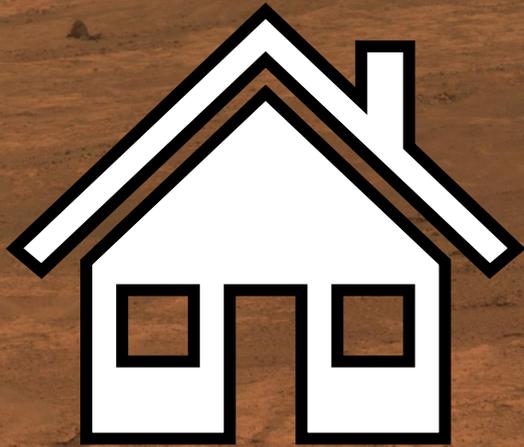- Accepts limited sample size range

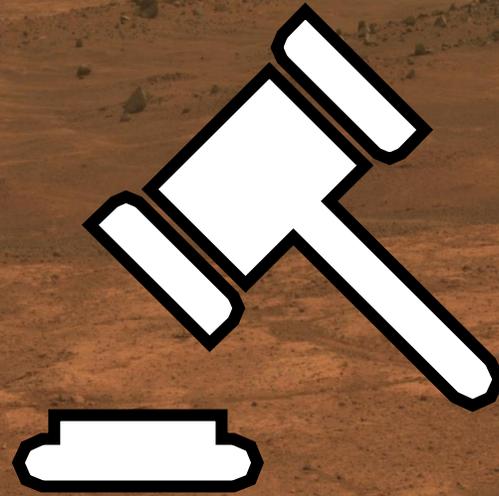- Limited mobility of the manipulator
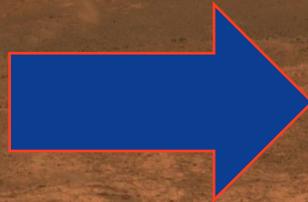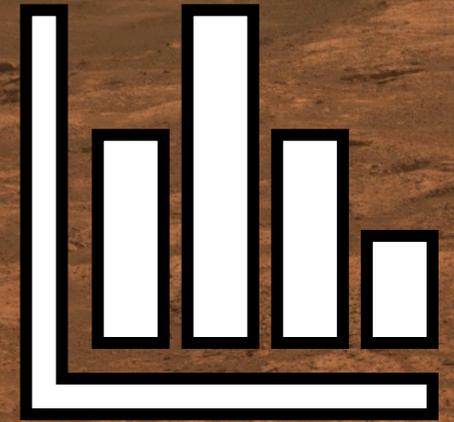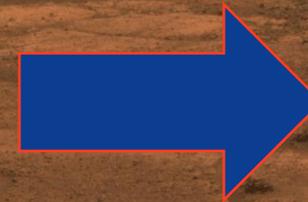
Victor Prado

Prototyping

Justin Bomwell

Concept Selection

House of Quality
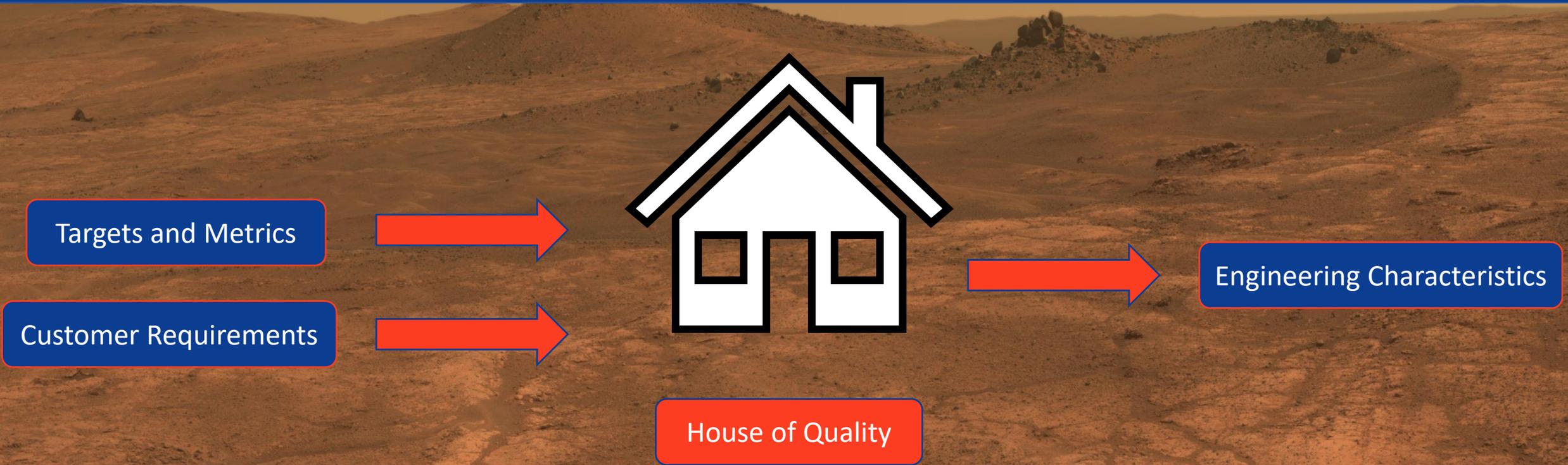
Pugh Charts

AHP

Justin Bomwell

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Concept Selection

Targets and Metrics →

Customer Requirements →

House of Quality

→ Engineering Characteristics

Justin Bomwell

Concept Selection

Concepts →

Engineering Characteristics →

Pugh Charts

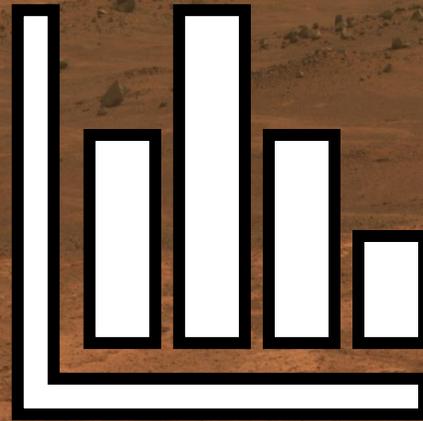→ Final Evaluation Concepts

Justin Bomwell

Concept Selection

Final Evaluation Concepts →

Engineering Characteristics →

AHP

→ Final Evaluation Comparison
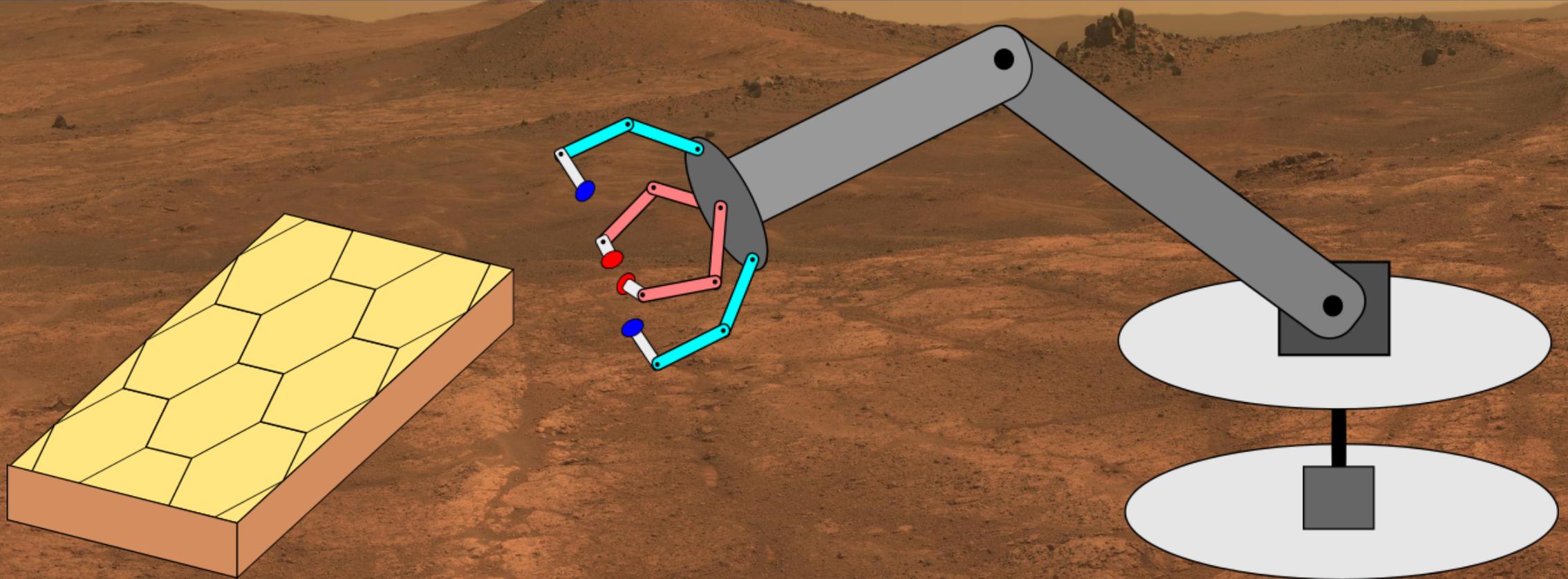
Justin Bomwell

Selection Criteria

Selection Crtieria for Concepts

■ Spin Fingers ■ Rock Picker ■ Microspine ■ Clamp Arm

| Weights: | MASS 0.072 | PRECISION 0.159 | SAMPLE SIZE 0.028 | STABILITY 0.401 | STORAGE 0.031 | ROTATION 0.308 |

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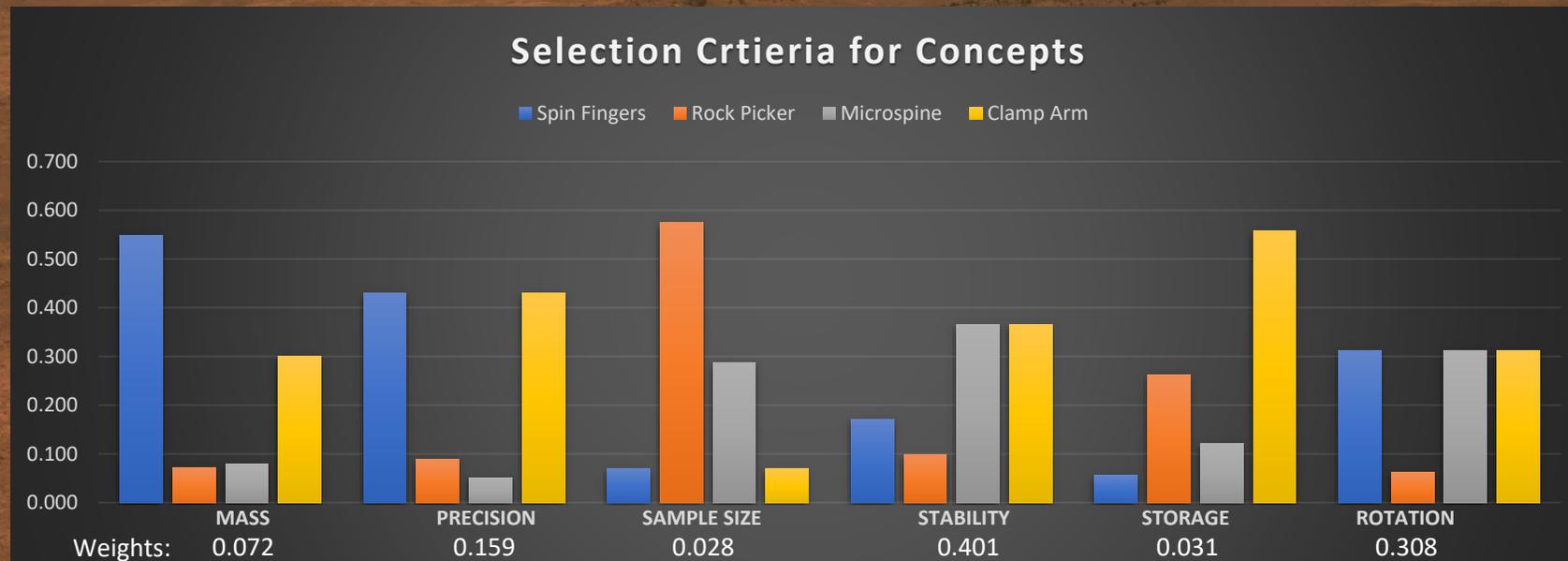
Final Selection

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Future Work

Risk Assessment
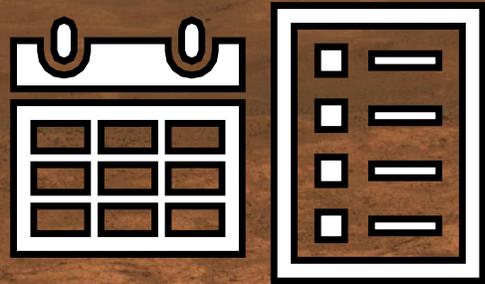
Spring Plan
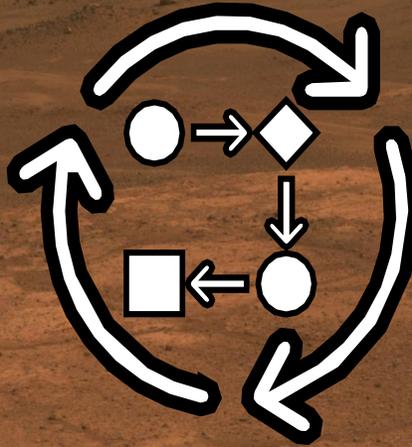
Simulations

Purchasing

Justin Bomwell

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References

https://mars.nasa.gov/mars2020/

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Final Selection