

# Portfolio

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Mechanical Engineering

Formula SAE Chief Engineer

Krenicki Scholar

# 2021 Internship

## Summary:

Worked with Separation & Destruct as a development engineer contributing to frangible joint development and testing.

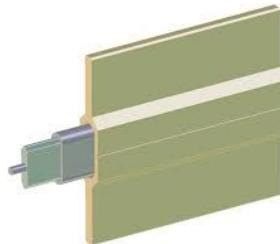
- Compiled free volume calcs for heritage manifolds to aid failure investigations
- Assembled extruded frangible joints for testing marginal coreload functional performance
- Emphasis on learning how products fail and ways to increase reliability

## Large Frangible Joint:

Brought concepts for scaled up tube assembly from concept to test ready.

- Designed multipart molds to cast silicone charge holder
- Formed 'race track' tube profile using custom forming dies
- Verified fabrication quality by measuring parts to ensure met tolerance requirements
  - Iterated fabrication tools to correct out of spec parts

Publicly available image of extruded frangible joint



## PDV Test Setup:

Helped prepare new photonic doppler velocimetry test equipment for measuring velocities during energetic events.

- Built test rigs to fixture detonators for first energetic tests
- Prepared Large XTA for test with PDV setup by designing jigs and probe placements
- Worked with high school interns teaching tools such as Solidworks to develop calibration device

# Machinist

## Optimizing Workflow for Short Production:

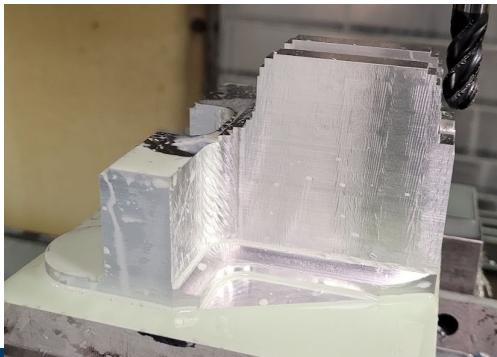
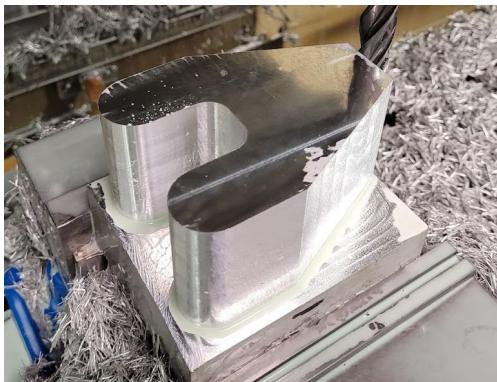
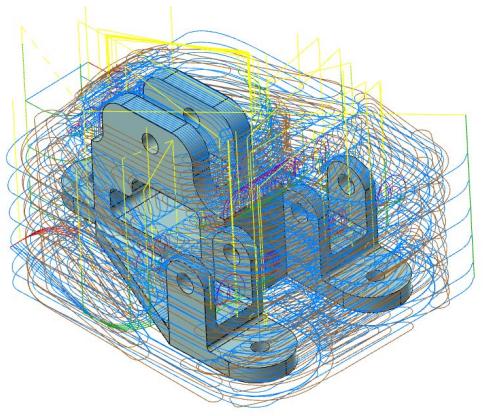
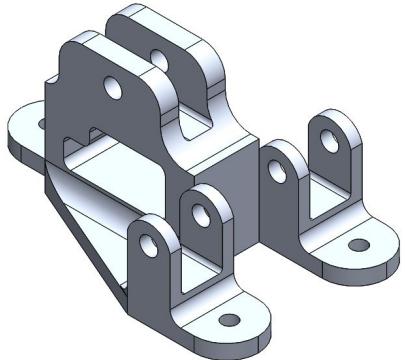
- Continuously improve process during production to increase quality and reduce waste
- Create workspace that promotes rapid prototyping
- Create versatile tool libraries to reduce setup time for unique parts
- Combine use of CNC and manual machine tools to work as efficiently as possible

## Design for Manufacturing:

- Working with students and professors to develop initial models into feasible products
- Understand requirements to balance speed and precision on a job by job basis
- Promote process understanding by creating hands on work environment



# Machining Process



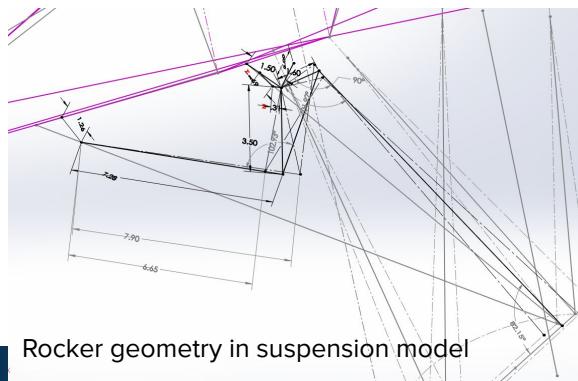
# Suspension Weight Optimization



## Suspension Rocker Redesign

Redesign rocker to reduce weight and ease manufacture. Manipulate suspension kinematics to maximize damper and anti-roll bar performance.

- Brought assembly through systems integration / design and into production
  - Utilized structural analysis and topology optimization to reduce weight and ensure reliability over life of vehicle
  - Balanced additional complexity of part with ease of manufacture by reducing setup time

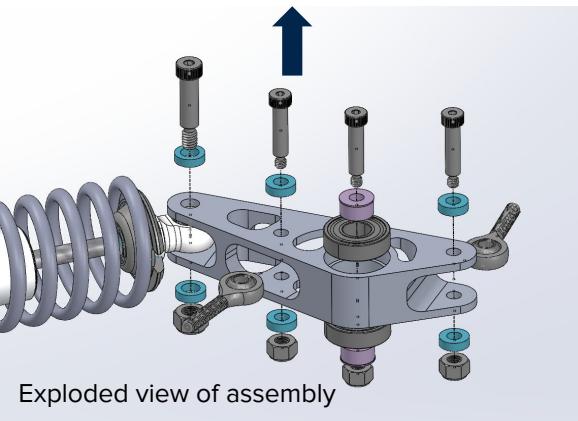


## Rocker geometry in suspension model

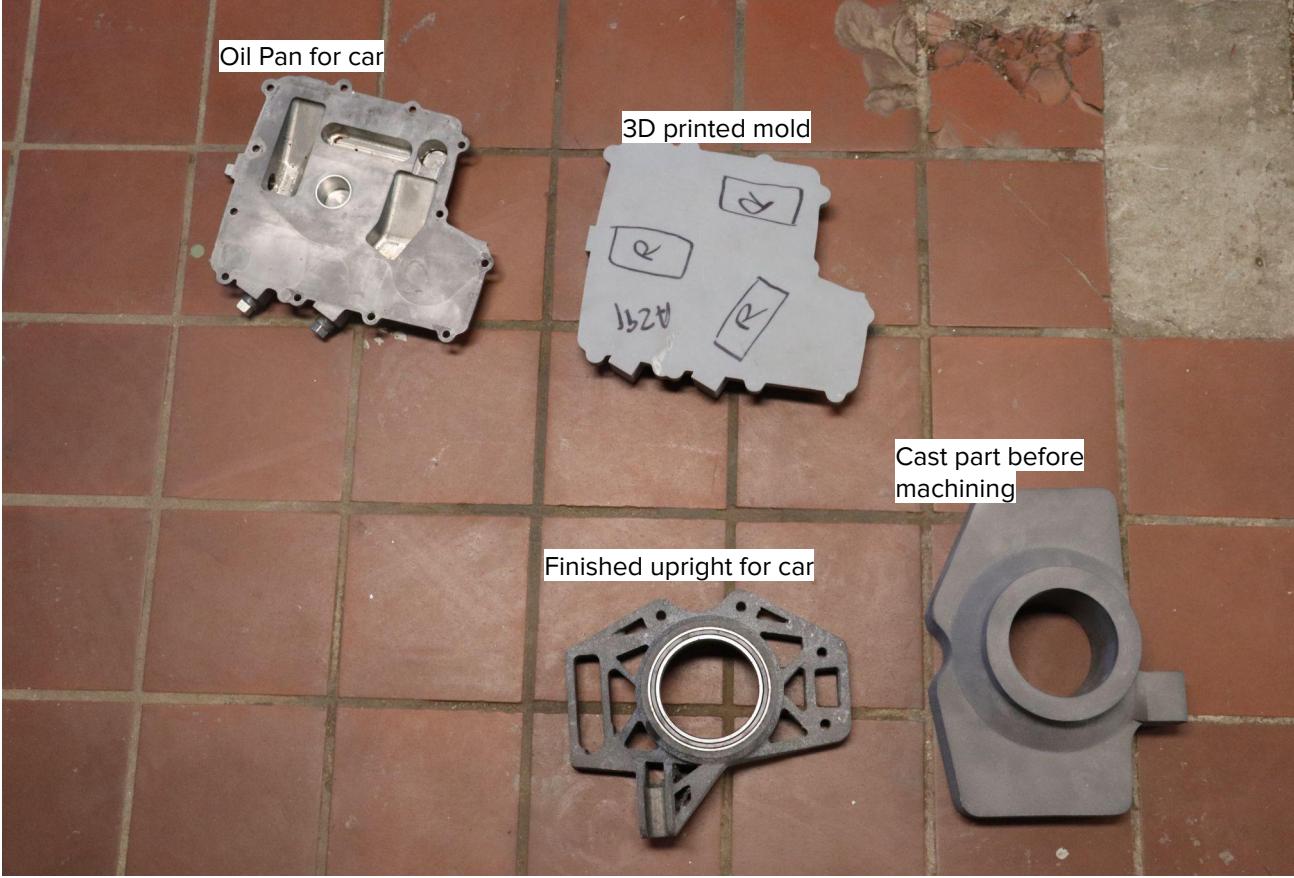
Ansys topology optimization



## Exploded view of assembly



## Machined part ready for anodizing



## Cast Magnesium Parts for Car

# Leadership and Team Development



## Ishu as Lead Welder

**Gap:** No student is capable of welding next frame in Fall.

**Action:** Develop Ishu into TIG welder, starting 6 months before start of frame weld.



TIG welding exhaust

**Result:** Ishu helped the team complete frame weld on schedule and to spec.

## Ethan as Mold Specialist

**Gap:** Aerodynamics package requires increased mold complexity and quality for composite fabrication.

**Action:** Ethan will design and lead fabrication of molds developing knowledge base for team.



**Result:** Ethan has expanded team knowledge base for composite fabrication. Developing into team lead.

## Abhi as Suspension Lead

**Gap:** Need suspension system lead for the next year with vehicle dynamics and aerodynamics experience.

**Action:** Develop driver with aerodynamics design experience to lead critical system integration for first time.



**Result:** Abhi successfully led design and fabrication of first suspension system built around aerodynamics package.



## Formula SAE Car in Action

# Results and Growth

## Michigan Competition:

Raced against other teams in 4 events during week long event.

- Placed 5th overall and 2nd in endurance race, best finish for team to date.
- Led technical upkeep of car ensuring 100% reliability during events
- Maintained team drive through technical and logistical challenges
  - Brake bias system redesign at event
  - Multiple 18+ hour days in a row

**5th  
Overall**

Out of 57 Universities from around the world

## New Partnerships:

Steadily growing sponsor base over year has significantly increased output quality.

- Procured Whitcraft as new sponsor bringing in fabrication work valued over \$10,000
  - Helping team develop more efficient production workflow
- Linde is now supply all welding materials with expected value over \$5,000
  - Training resources will significantly increase shop safety
- Proposed new funding request to Dean of Engineering ensuring long term team stability



# Hobbies: Working Fast and Working Slow

I love to work with my hands in as many forms as possible. That means that some projects look very different from others.



One day design and build of mechanical camming device for rock climbing. Goal was to build a functional prototype as quickly as possible.

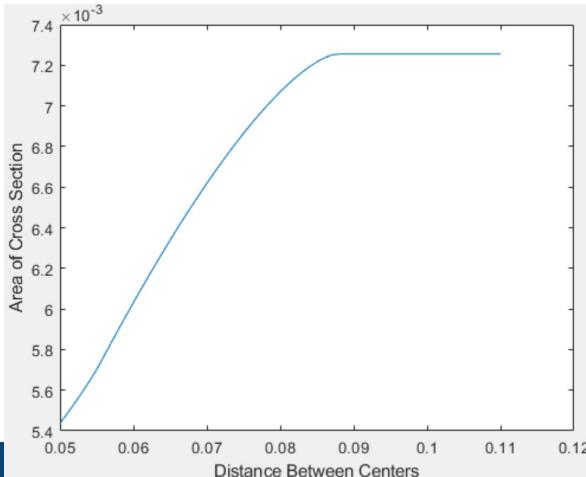
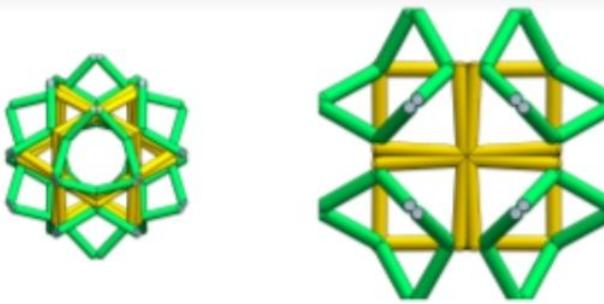


Blacksmithing is nearly the opposite with a intent behind every hammer stroke progress is slow and steady.

# Undergraduate Research

## Modifying Structures for Manufacture:

- Worked with optimized anisotropic tubular lattices
- Modified non manufacturable geometry produced by optimization
  - Worked with Lawrence Livermore National Lab to understand advanced 3D printing capabilities
- Created internal ductwork to drain internal dissolvable support from large scale structure
- Created Matlab tool to understand how modifications could impact performance



1. Leadership and team development skills
2. Hands on design and fabrication experience
3. Ability to work with suppliers and customers

# Thank You

