Spring Midterm 2 Presentation

HANScycle: Reciprocating Lever Transmission

Team 8:

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Instructors: Dr. Chiang Shih

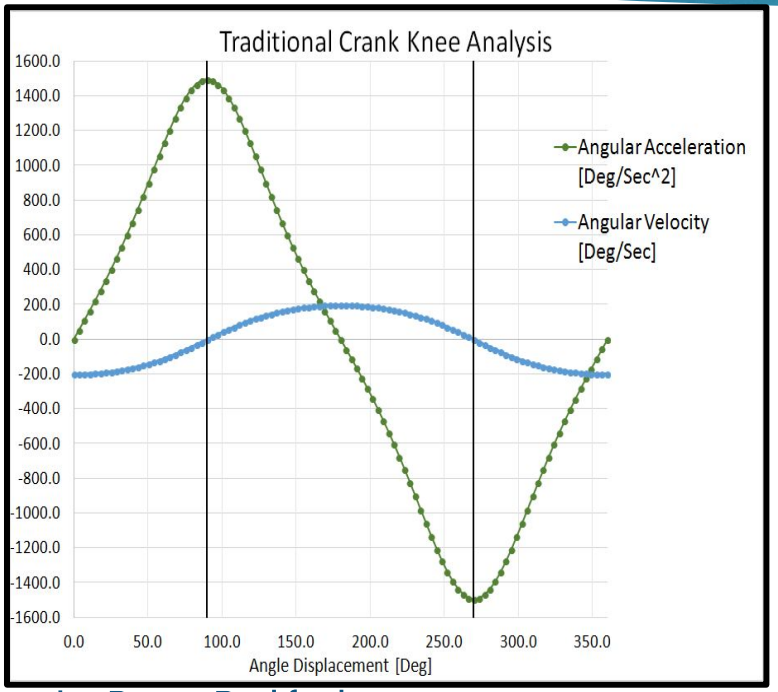
Introduction

- Project Goal:
  - Build a working HANScycle prototype using the Reciprocating Lever Transmission
- Constraints:
  - Bicycle must be designed for 26” wheels
  - Bicycle must fit into a 26”x26”x10” storage box
  - Utilize crank arms no longer than 12” with arc no greater than 100º
  - Utilize existing prototype
- Budget: $2,000

Motivation/Background

- Why this design?
  - Trouble riding uphill
  - Everyday commuting
  - Better pedal motion
  - Produces more power and torque
  - Dead spots at 90º on a traditional bike
  - Minimize joint damage

Knee Joint Damage



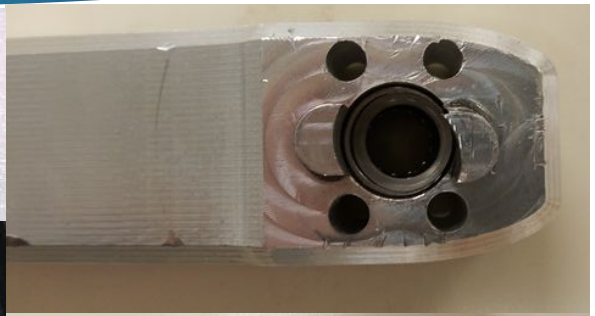
- Dead spots causes internal forces on knee joints which can lead to:
  - Permanent knee joint damage
  - Dislocated joints
- The knee is where the most damage is caused in cycling.

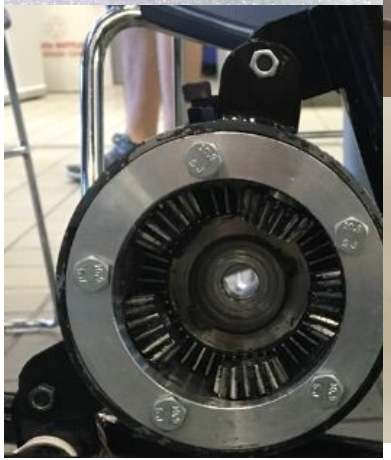
Team 8 Yearly Goals

- Test prototype for comparison data
  - Various crank arm lengths
  - Torque, Power, Cadence, Speed
  - Compare values with traditional bicycle
- Redesign components
- Focus on ergonomics

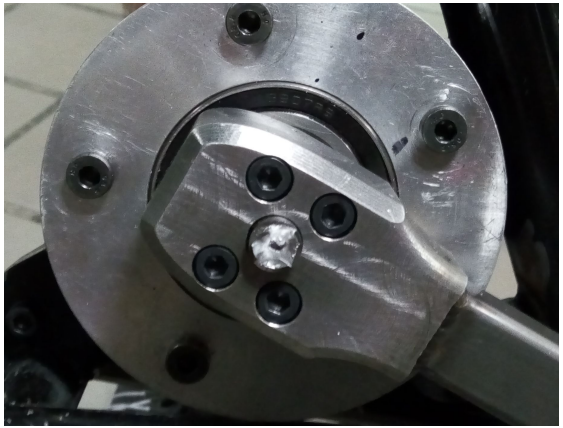
Failed Components

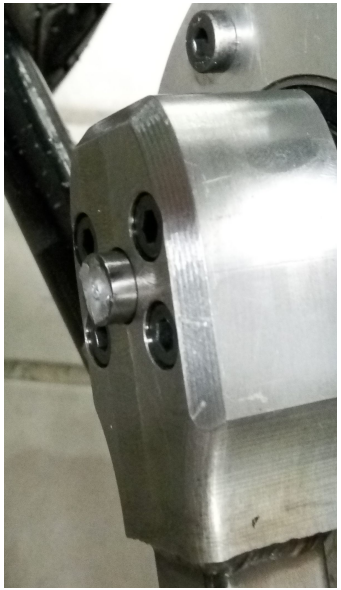
- Crank arms
- Bolts sheared
- Shaft misaligned
- Needle bearing broke
- Ratchet and pawl
- RLT brackets flexed under load
- Output shaft sheared



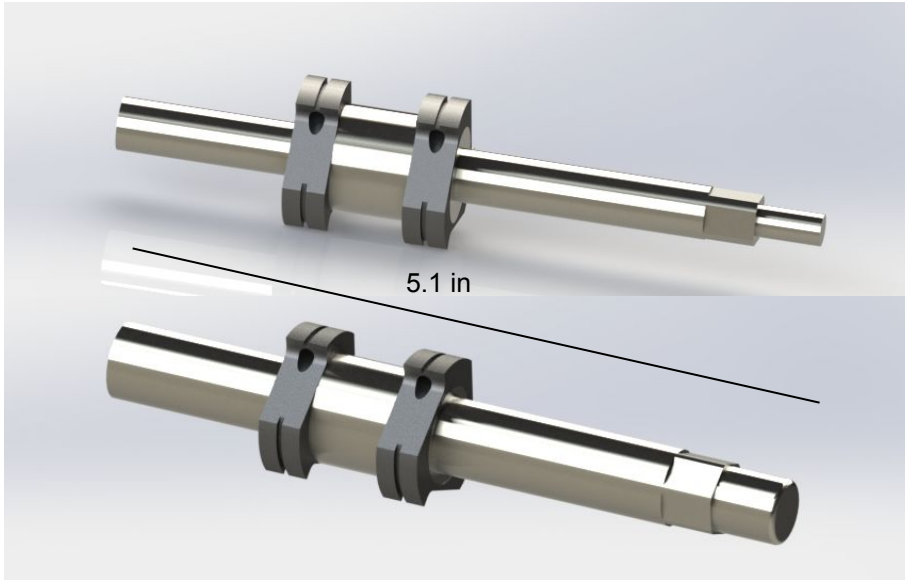


Most Recent Failure



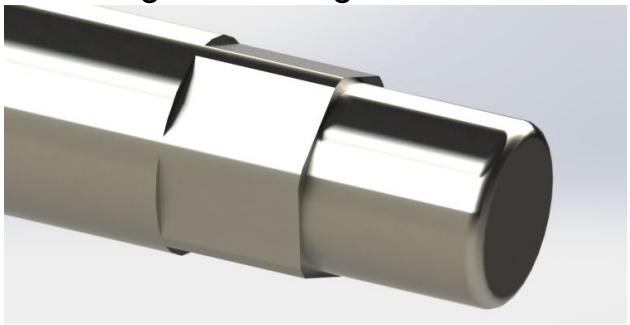


New Output Shaft



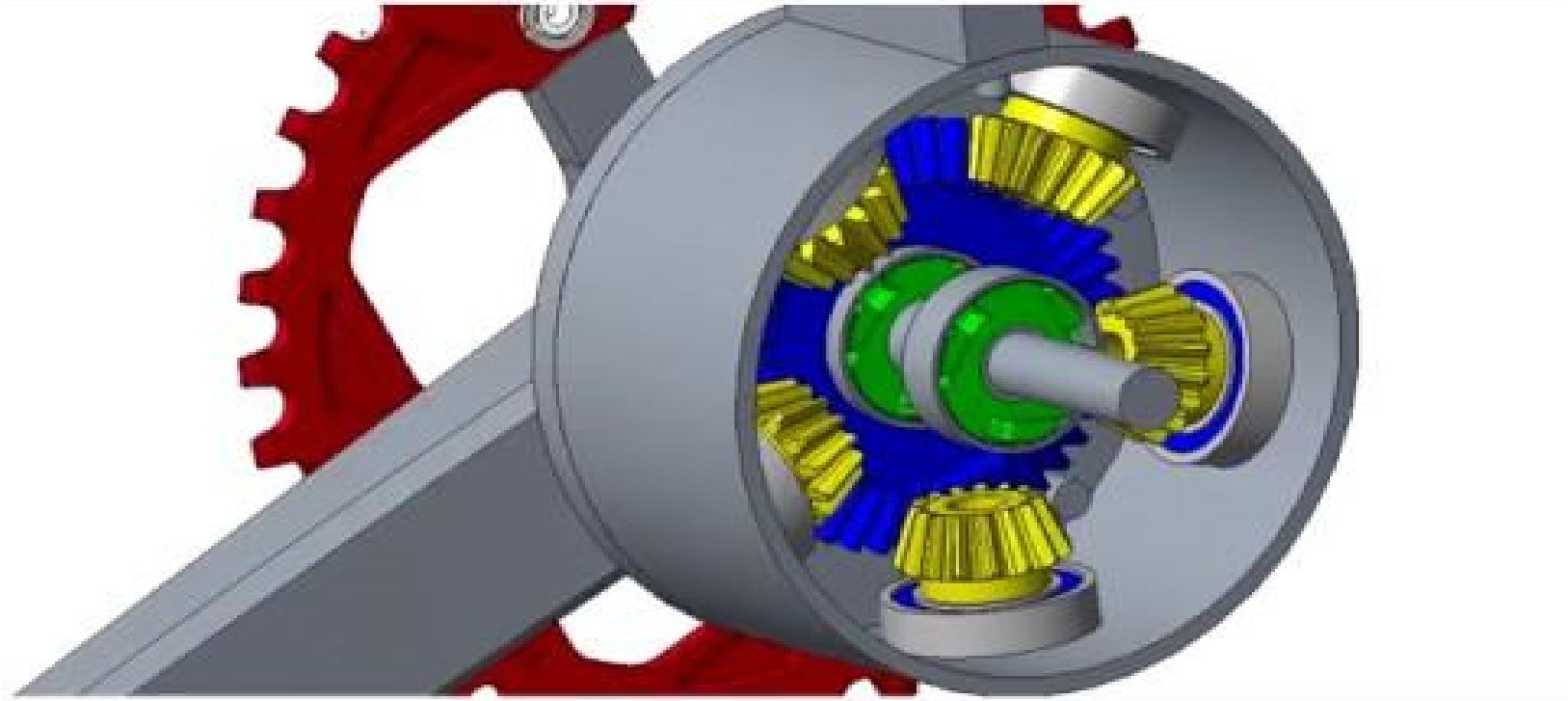
Old output shaft (above) vs new output shaft (below)

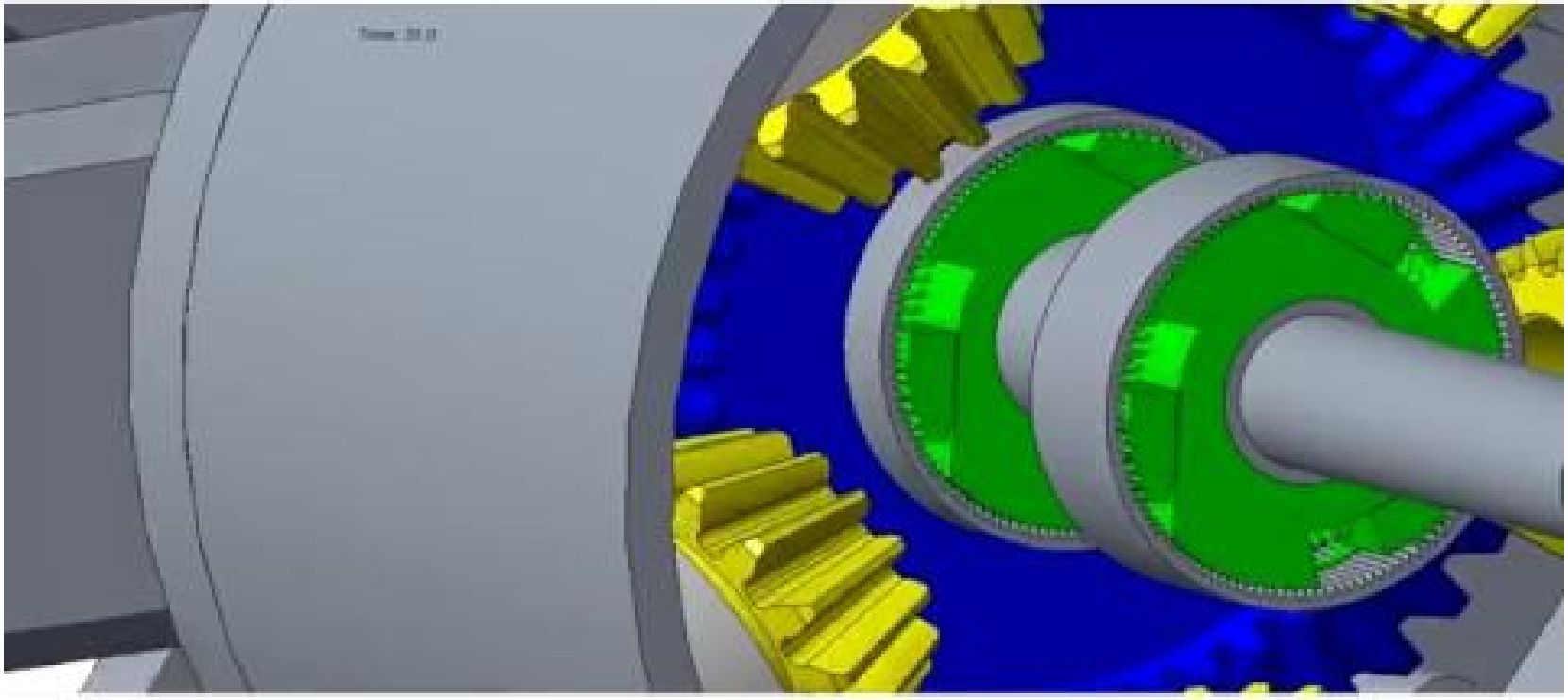
- Significant Changes:
  - Shaft is 40% larger in diameter
  - Shaft to chainring adapter mating point is 50% larger.
  - Material: 8620 steel
  - Hexagonal mating surface



Hexagonal section

Presenter: Nicholas Khayata



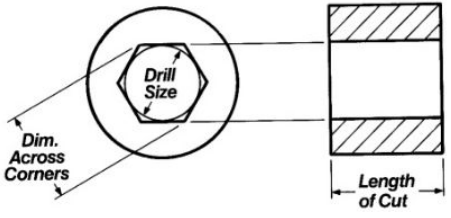


Updated Budget (Spring)

#	Part	Vendor	Cost	Quantity	Subtotal
1	½ in. Hexagon Broach	McMaster.com	$241.89	1	$241.89
2	M12-1.75 Class 10 flange locknut	McMaster.com	$10.65	1	$10.65
3	⅞ in. diameter 3 ft. 8620 alloy steel rod	McMaster.com	$22.68	1	$22.68
4	14mm ID 18mm OD Oil-embedded sleeve bearing	McMaster.com	$1.75	4	$7.00
5	14mm ID 16mm OD Dry-running sleeve bearing with steel shell	McMaster.com	$4.23	2	$8.46
				Total	$290.68
				Remaining Budget	**$894.66**

Future Plans

- Implement the new output shaft
  - Machine larger 16mm holes
  - Press fit oil-embedded bushings with 14mm ID
  - Use a hexagon broach in order to maximize mating surface
  - Install the larger output shaft
- Optimize ergonomics
  - Select cruiser/urban style handlebars
  - Select a larger cruiser/urban style seat



Future Suggestions

- Future Suggestions
  - Spline the output shaft for optimum mating surface
  - Increase gear ratio to increase maximum speed
  - Custom made replacement ratchet pawl system

References

- [1] "Hexagon Broaches | Hex Dimensions Across Corners." DuMONT. Web. 23 Mar. 2017. <http://dumont.com/our-broaches/hexagon-broaches/>
- [2] G. H. Hansen, "Reciprocating Lever Transmission.," Patent US20130205928 A1, 2013.
- [3] "McMaster-Carr." McMaster-Carr. Web. <https://www.mcmaster.com/>
- [4] SUB1.5-4515." KHK-USA. N.p., n.d. Web. 20 Mar. 2017. <https://www.khkgears.us/catalog/product/SUB1.5-4515>.
- [5] Web. 26 Mar. 2017. <http://www.bicycling.com/sites/bicycling.com/files/posture-main.jpg>.

Questions?