# Min Seo Kim

Mechanical Engineering at Carnegie Mellon University

minseoki@andrew.cmu.edu

linkedin.com/in/min-seo-kim

+1 (408) 613-3966

## Bicycle Crank

### How?

- Iterative design process involving rapid prototyping (50+) and testing
- Iteration 1: Acrylic rectangular piece prioritizing minimal weight
- Iteration 2: PLA cylindrical tube minimizing torsional stress
- Iteration 3: PLA dog-bone geometry to localize point of failure

### TESTING

Iteration 1:

- Hollow design with central support beams
- Premature breakage at support
- Real life != CAD simulation

Iteration 2:

- Adopted circular cross-section to reduce torsional stress
- Bent under load due to print pattern
- Print direction, layering, and thermal bonding significantly affect part strength

Iteration 3:

- Introduced reinforced supports, vertical print orientation, and adjusted layer cooling to control failure location

### Challenge

- Inverse design a lightweight bicycle crank using acrylic or PLA that fails at a 40 N pedal load

### Results

- Dog-bone bicycle crank weighing 5.2g made of PLA
- “Brittle” failure at 37.8 N (8.5 lbs) of force

### DESIGN / FEA

- Designed in SolidWorks
- Used hand calculations to determine torsional and bending stresses using ductile yield criterion
- Used FEA simulations to verify factor of safety, visualize weak points, and confirm likely failure regions
- Incorporated analysis results into iterative prototyping, refining wall thickness and diameter until achieving consistent failure at ~9 lbs