# Adaptive Bicycle Design for Veteran Mobility

PROJECT S.E.R.V.E.
GALLOGLY COLLEGE OF ENGINEERING
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## Problem Statement

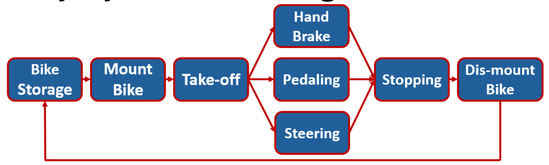
A veteran with limited flexion in his left knee is unable to ride a standard bicycle comfortably and safely. This project focuses on modifying a pre-existing bicycle to accommodate his specific range of motion, validating fit using anthropometric and range-of-motion analysis, and ensuring the final design is safe, stable, easy to use.

## Constraints

- Left knee ROM limited to 14° short of full extension and 98° flexion
- Support a 280 lb, 6’2” rider
- Maintain braking, steering, and safe mounting/dismounting
- Based on a Specialized Sirrus X 1.0 bicycle
- Budget ≤ $2,500 (Project S.E.R.V.E.)

## Data Collection & Bike-Rider Analysis

- Virtual anthropometric body-segment measurements used to define rider–bike geometry, system modeling, and verification.

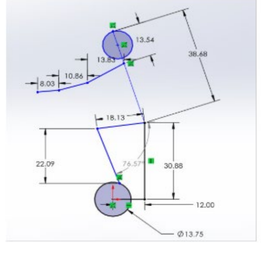



Bicycle Operation Process Flowchart

## System Modeling



Planet Fitness Stationary Bike



SolidWorks Model

- Modeled rider–bike geometry in SolidWorks to evaluate pedaling within knee ROM

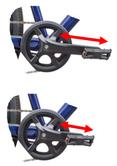
## Codes

- Standard fastening practices
- Material selection
- ISO 4210 – Bicycle safety
- CPSC – U.S. safety regulations

## Design Alternatives Considered



Separate Crank Arms



Permanently Shortened Crank Arm



Horizontally Adjustable Seat



Static Angled Seat

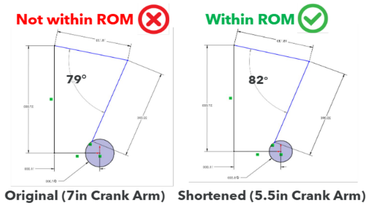
## Selected Design & Verification



T – Cycle Easy Knees Pedal Swing and Crank Shortener Kit

- Original crank: 7 in
- Seat adjustment: 5.6 in vertical, 1 in horizontal
- Required crank reduction: ≥ 1.5 in

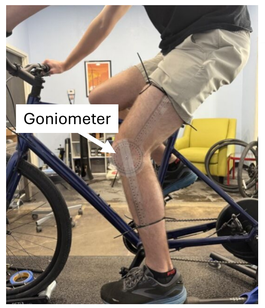
**Crank Arm Analysis Results**

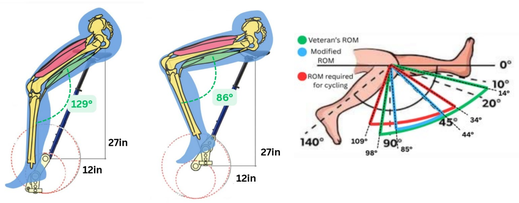



Original (7in Crank Arm) Shortened (5.5in Crank Arm)

- **Swing Arm Pedal Attachment**
  - Adjustable
  - Easy to install & maintain
  - Keeps Left knee in required ROM

## Final System, Verification & Costs




**Modeled Maximum Extension and Flexion**

- Goniometer testing on an anthropometrically similar subject confirmed compliance with required ROM




**Final Modified Bicycle with Adaptive Components**

- Total project cost: **$1,375**, including bicycle, added components, and shipping to the veteran

## Selected Design & Verification

We'd like to give special thanks and acknowledgements to Wheeler Dealer Bicycles, Buchanan Bicycles, Planet Fitness, and Project S.E.R.V.E. for all of their assistance and expertise regarding this project.