How can the forces applied by a rider to a bicycle be measured and used to estimate the rider's pose on the bicycle?

**Motivation**
Bicycles provide compact, affordable, and sustainable transportation, but may be difficult to use for people with balance impairment. Bicycle training has also been demonstrated as an effective way to provide rehabilitation for individuals suffering from the effects of stroke and Parkinson's disease [1, 2]. Adding balance assistance may be an effective way to increase bicycle accessibility.

**Research Methods**
- The primary goal of this work is to provide a platform for studying the physical interaction between a rider and a bicycle.
- This work involves constructing the mechanical and electrical systems measure the interaction forces, along with the software to interpret the collected data.

**Progress**
- Designed and fabricated force sensors for handlebars, pedals, and seat.
- Added sensors to measure bicycle joint angles and speed.
- Programmed data acquisition system to record all sensors.
- Conducted preliminary testing.

**Future Work**
- Controlled motion capture experiments to collect more useful data for training and model validation.
- Predicting rider pose and steering intent from interaction forces.
- Integration of this system with the robotic self-balancing bike.

**Fig. 1:** Human-bicycle interaction force sensors. (a) Pedal load cell. (b) Force seat for measuring center-of-pressure. (c) 3-axis force handle grip.

**Fig. 2:** The center of mass and human intention can be estimated by measuring contact forces between the rider and bicycle [3].

References