Electric Mobility Tricycle: Head Tube Angle Redesign

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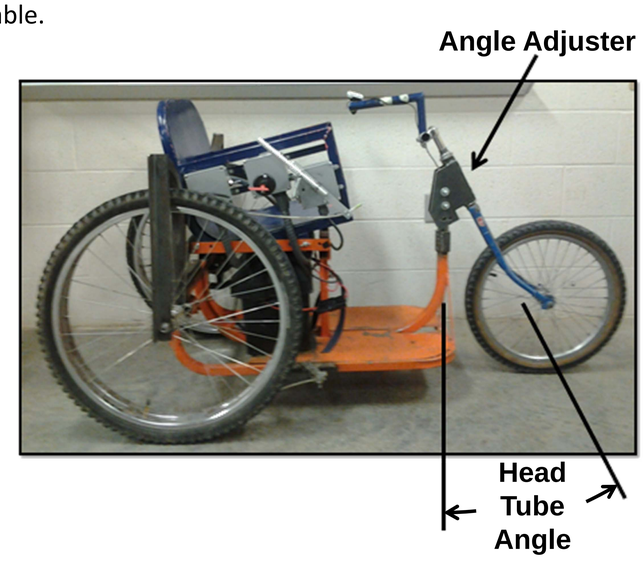
Overview

The Mobility Tricycle Project designs electric and hand-powered tricycles for physically disabled people in Burkina Faso, West Africa. In order to do so, we partner with the Center for the Advancement of the Handicapped in Mahadaga, Burkina Faso, by providing the center with detailed building plans for our tricycle design. Our goal is to improve the quality of life of disabled individuals by restoring their mobility. While much of the tricycle design has been carefully considered and optimized, one area in particular, the front-end of the tricycle, can still benefit from a systematic redesign. Our project was based on examining how the tricycle head tube angle affects the handling of the tricycle. A poor choice of this angle can pose problems for riders who might find the tricycle too hard to turn or keep going straight. In addition, the tricycle fork will begin to wobble, or shimmy, at higher speeds which increases handling difficulty. Our aim was to determine the optimal head tube angle in order to decrease wobble while also making the tricycle easier to turn and more stable.



Acknowledgements

We would like to thank our advisors, Dr. Tim Van Dyke and John Meyer, and consultant Dr. Don Pratt for their contributions to this project.

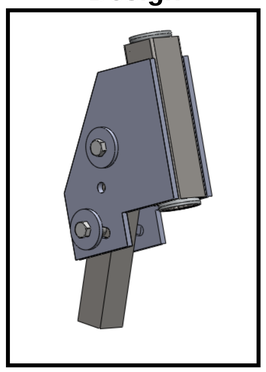
Further Information

For more information about the Mobility Tricycle Project, please visit: www.thecollaboratoryonline.org/wiki/Mobility_Tricycle_Projects.

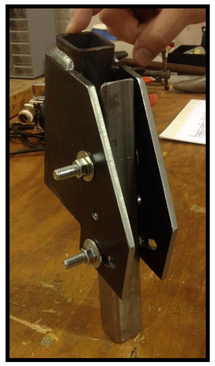
Angle Adjuster

- Purpose: To allow the head tube angle to be manually adjusted to the desired angle in order to conduct tests at different angles
- The design needed to be able to be installed on the existing electric tricycle

Design



Fabrication



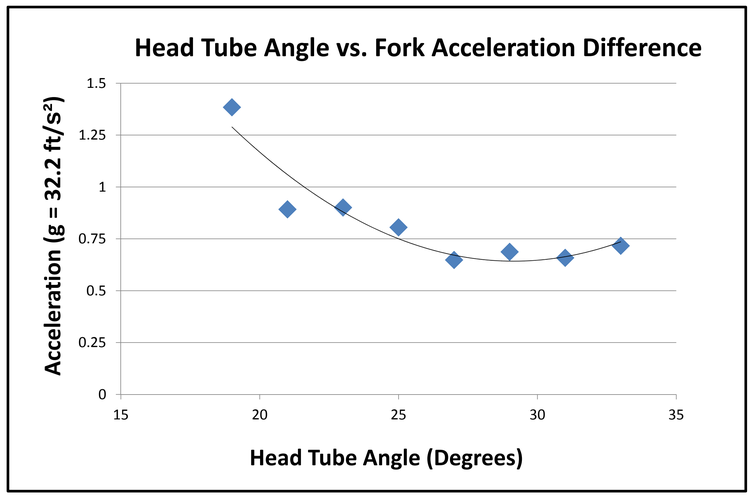
Installation

Angle Adjuster Design:

- Middle bolt can be used to fix angle at 25° (current design)
- Bolt in slot can be used to adjust angle a *maximum* of ±10°
- Welded directly onto existing tricycle frame

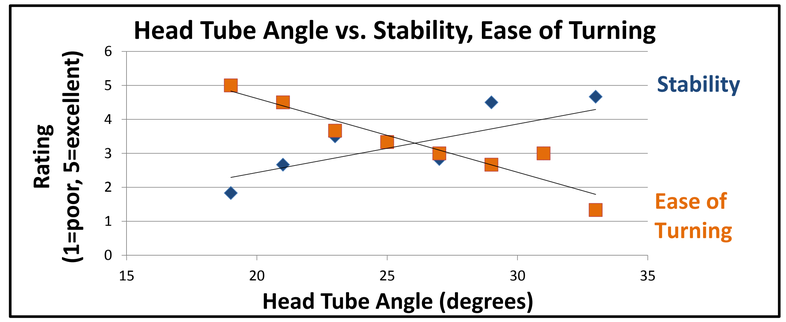
Wobble Test

- Measured the acceleration of the front fork due to wobble using an accelerometer
- Analyzed the max. and min. acceleration over a period of time and calculated the differences in each angle tested
- Higher acceleration difference indicates greater wobble



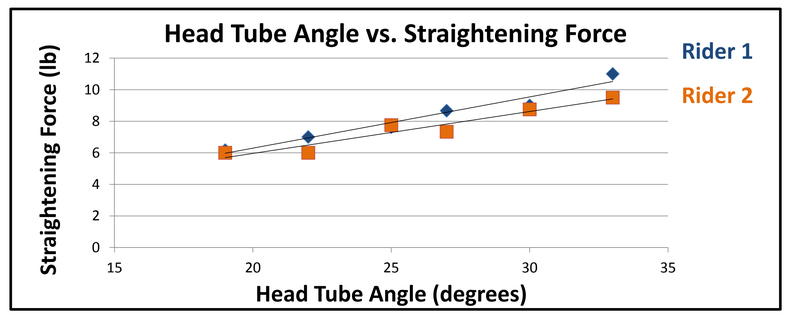
Handling Test

- Maneuvered trike through handling course as fast as possible
- Recorded completion time and rider observations concerning stability and ease of turning using a rating system
- Goal was to examine the relationship between head tube angle and general handling (i.e. stability and ease of turning)



Straightening Test

- Measured the force needed to keep the trike travelling in a straight line (trike naturally turns right when driven)
- Goal was to examine the relationship between head tube angle and the straightening force



Conclusions

- Straightening force increases linearly with the head tube angle
- A head tube angle at or near 26 degrees will provide the best balance between stability and ease of turning
- A head tube angle at or near 29 degrees will produce least wobble

We recommend keeping the head tube angle at 25 degrees. Although the wobble test suggests that we should increase the angle, we believe that the decrease in wobble expected from increasing the head tube angle is not significant enough to warrant increasing the straightening force. Furthermore, the handling test shows that 25 degrees provides a good balance between stability and ease of turning.