



# Design of Automated Cut Guide for Orthopedic Surgery

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## Abstract

Currently, orthopedic surgeons use numerous instruments in order to complete joint surgeries. These instruments require meticulous manual adjustments creating long, difficult surgeries. Due to this fact, there is an urgent need to develop new, easier to use instrumentation which will reduce surgery time.

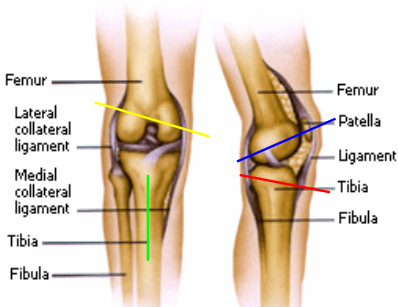
It is the goal of the Automated Cut Guide design team to create an instrument for knee replacement surgery which greatly reduces the need for manual input, provides the surgeon with ease of use and, in the end, shortens surgery duration.

## Introduction

Orthopedic technology involving surgical cutting guides, to date, have consisted of manually altered components that require fine tune adjustment that could be tedious and time-consuming to correctly align in three dimensions. When two axes are properly aligned, the third is difficult to place without misaligning the first two that were already properly setup.

For this project we have developed instrumentation, software, and technology to assist in primary femoral and tibia resections in non-navigated, and possibly navigated, surgeries. The instrumentation will be used only for Zimmer Legacy Posterior Stabilizing (LPS) surgical techniques and Total Knee Arthroplasty (TKA) incisions and is intended to replace manual tuning via wireless technology.

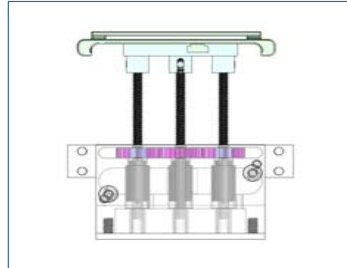
Tolerances are in place to provide accuracy when aligning the cut guide wirelessly. Validation of the tolerances used will be completed with Zimmer's Computer Assisted Solutions Electromagnetic Paddle system, during testing.



Necessary movements from the device:

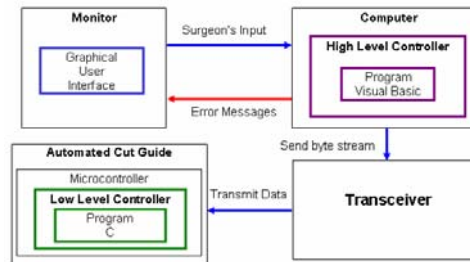
- Varus/Valgus
- Flexion/Extension
- Distal/Proximal
- Anterior/Posterior

## Mechanical Design



Front view of the final mechanical design.

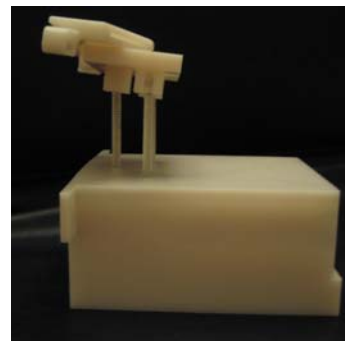
## Software Design



## Design



Front View



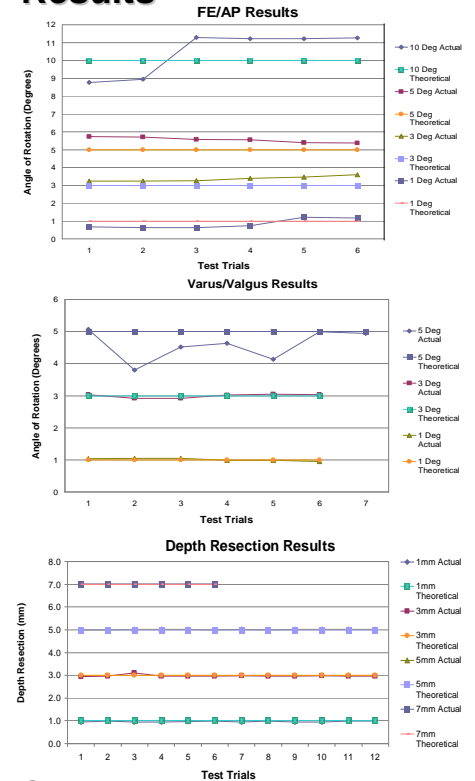
Side View

## Acknowledgments

The Automated Cut Guide team would like to thank our advisors Dr. Bongsu Kang and Dr. Chao Chen for their support and guidance throughout this project. Their knowledge and advice have contributed to our success thus far.

We would also like to thank our sponsor, Zimmer, Inc., for providing us with an opportunity to work on this project. The continued support and technical assistance Zimmer, Inc. has provided has proven to be invaluable. In particular, we would like to thank Jackson Heavener, Senior Engineer I CAS Group, for his dedication and input into this project. Without his expertise and fortitude, this project would have never happened. We would like to also thank First Gear Engineering & Technology for allowing us to complete our system testing at their facilities.

## Results



## Conclusion

The following requirements were set by our sponsor, Zimmer Inc.

- $\pm 2\text{mm}$  and  $\pm 2^\circ$  accuracy for translational and angular movements
- $\pm 15\text{mm}$  of translation
- $\pm 10^\circ$  of rotation

With a maximum error of .150mm and  $1^\circ 17'$ , our device functions well within the accuracy requirement for each type of movement.

It was also proven that our device meets the range requirements by performing limit tests.

In summary, our device functions within the requirements given and has exceeded the expectations of our sponsor.

**Note:** These test results reflect the testing done on April 10<sup>th</sup> and 11<sup>th</sup> of 2007 on a bread board.