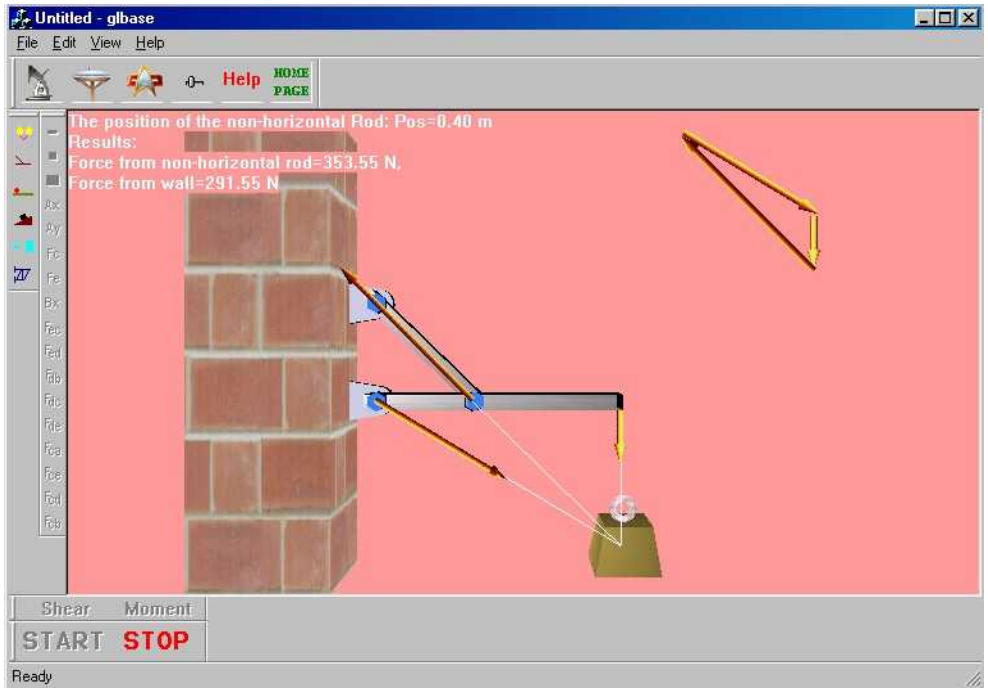
Haptics-Augmented Undergraduate Engineering Education



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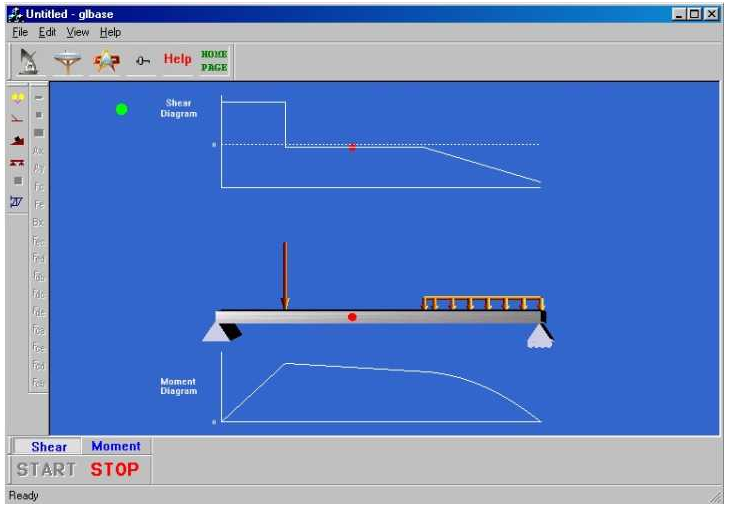
Ohio University
ICEE, Engineering Courseware
Gainesville, FL, October 18, 2004

Outline

- Haptics Definition
- Motivation
- Proof-of-Concept Project
- Haptics-Augmented Courseware
- Software Design Evaluations
- Commercialization
- Project and Related References
- Related Projects
- Conclusion

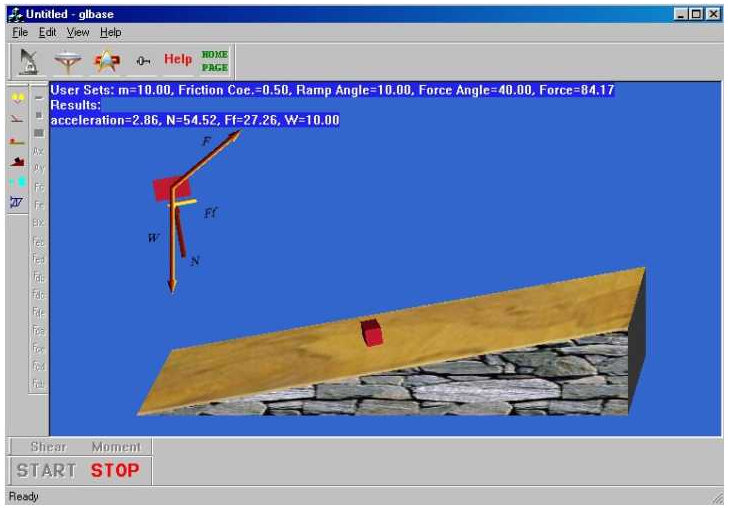


Motivation

The Problem: Current example and homework problems in basic undergraduate engineering courses are flat, static, boring, and non-engaging. In the worst case this leads to attrition since some students fail 'weed-out' courses three times. Even for the best students, current practices do not engage them fully, and deep learning, understanding, and retention of fundamental principles may not be achieved.

Our Vision: To produce a new generation of animated, interactive 'Schaum's Outline Series' on CD, with force feedback ("feeling is believing"), for augmenting the learning and teaching of basic and advanced undergraduate engineering courses nationwide. To focus on applying educational pedagogical research to improve the quality of education for all students in undergraduate engineering programs, rather than focusing on the requisite technology.

Our Hypothesis: Use of interactive, haptics-augmented activities in conjunction with standard engineering courses will promote deeper learning and understanding and reduce student attrition nationwide.



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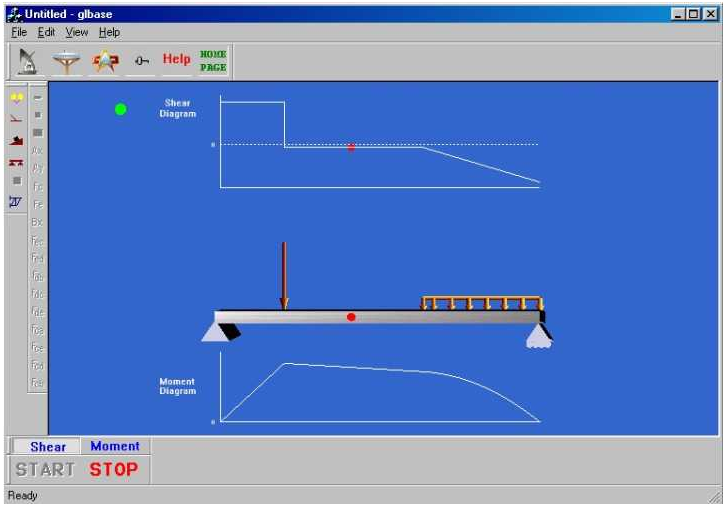
Proof-of-Concept Project

- NSF Grant DUE-0126739
- Development and Software Design Evaluations
- www.ent.ohiou.edu/~bobw/html/HapEd/NSF/UGHome.htm

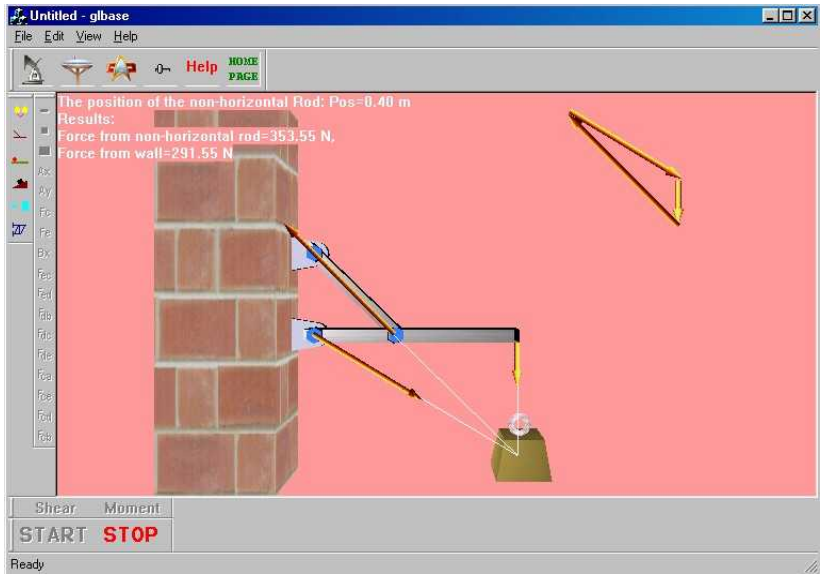
Physics	Statics	Dynamics
1. Vector Addition: Boats Towing Barge 2. Concurrent Forces: Three-Force Member 3. Projectile Motion 4. Newton's Three Laws 5. Interactive Dynamics Free-Body-Diagram 6. Conservation of Linear Momentum 7. Non-concurrent Forces: Truss Structure Reactions	1. Vector Addition: Boats Towing Barge 2. Concurrent Forces: Three-Force Member 3. Interactive Statics Free-Body-Diagram 4. Beam: Shear and Moment Diagrams 5. Pulleys 6. Statically-Determinate Truss Structure	1. Projectile Motion 2. Newton's Three Laws 3. Interactive Dynamics Free-Body-Diagram 4. Conservation of Linear Momentum 5. Conservation of Energy 6. Particle Dynamics: Box Motion 7. Rigid Body Dynamics: Box Motion



Haptics-Augmented Courseware

Common to all of our haptics-augmented software activities:

- Student enters various simulation parameters
- Graphical display of configuration and animation
- Display of vector force diagram
- Display of answers for student to check
- Real-time graphs
- Student chooses to ***feel*** the different vector forces involved



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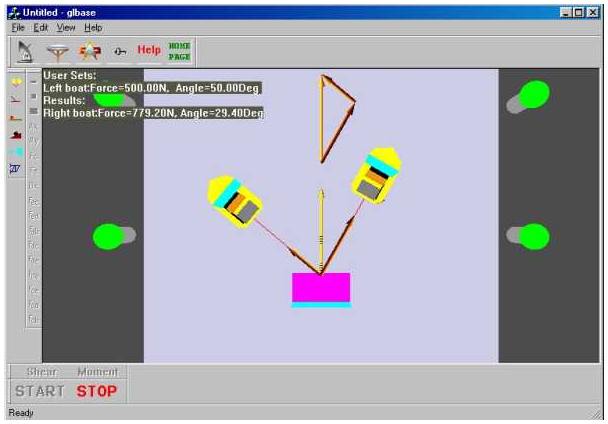
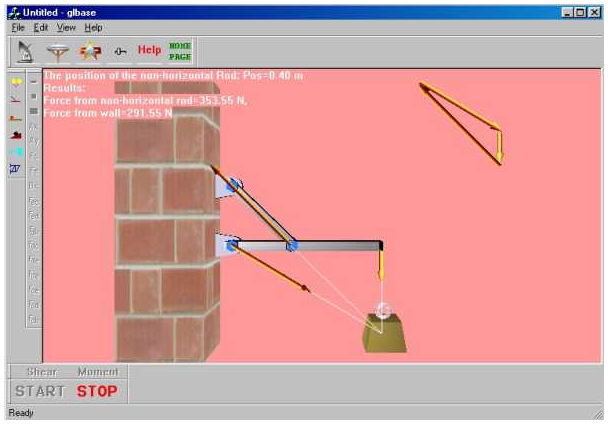
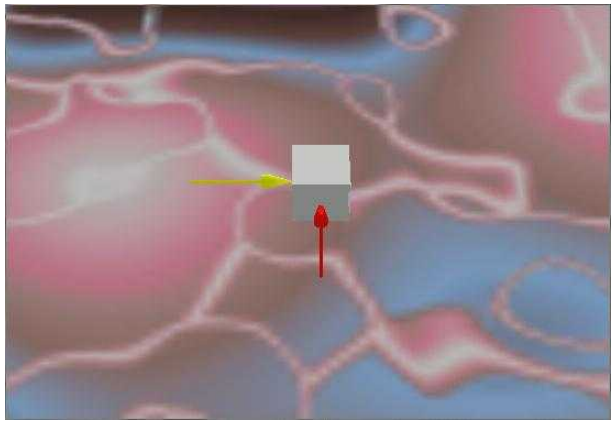
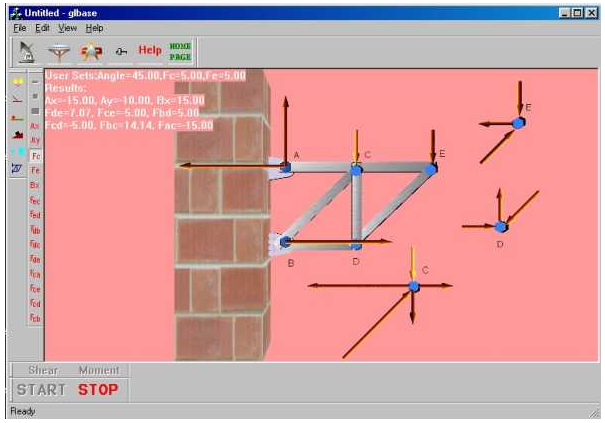
Haptics-Augmented Courseware

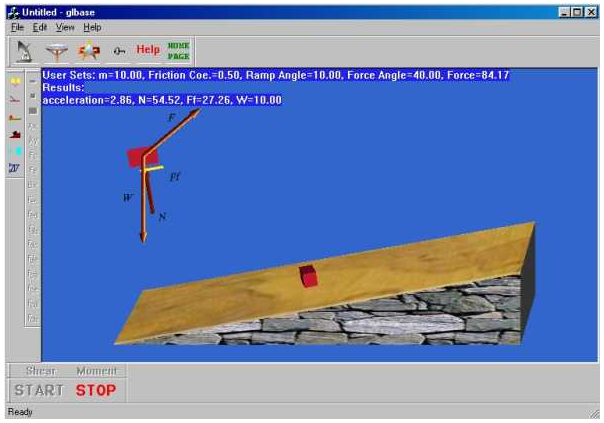




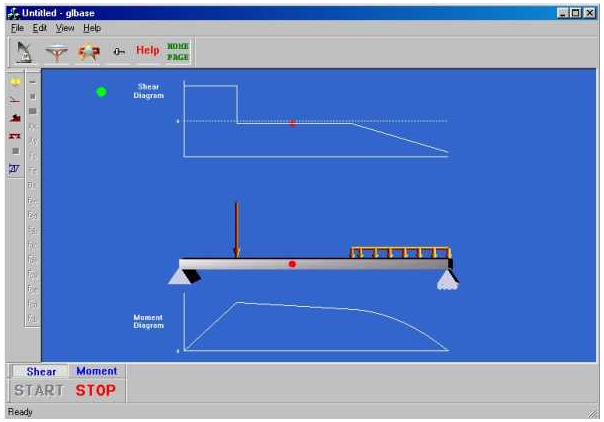


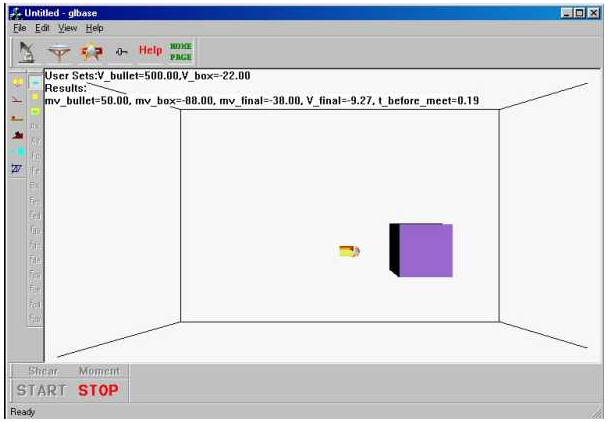
Haptics-Augmented Courseware

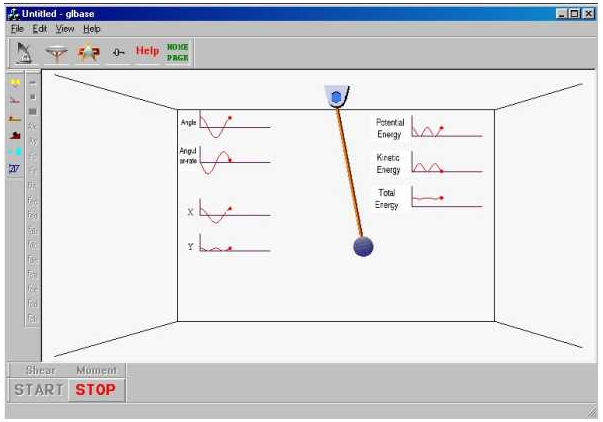


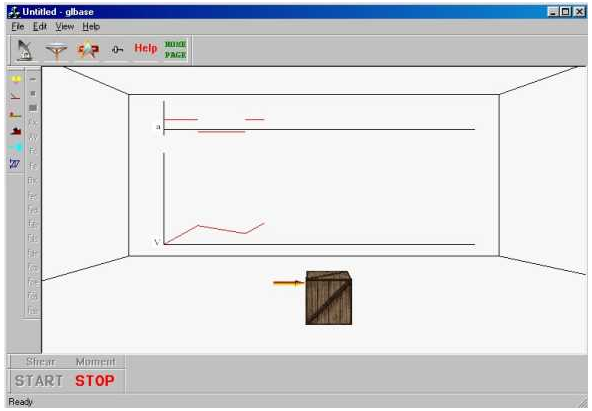


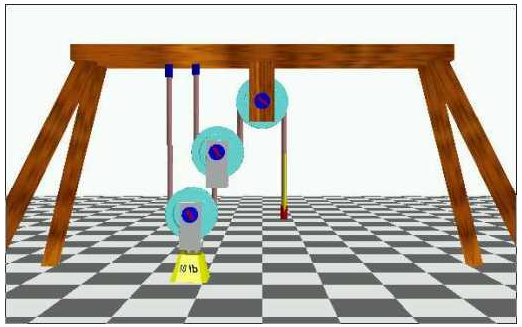
Haptics-Augmented Courseware











Software Design Evaluations

- Part I: Evaluation of Content 4=VE, 3=Eff, 2=NE
- Part II: Evaluation of Software Design 4=SA, 3=A, 2=D, 1=SD
- Part III: Evaluation of Learning Environment 4=SA, 3=A, 2=D, 1=SD

Physics (*n*=64)

Section	Mean	Standard Deviation
Part 1	3.40	0.31
Part 2	3.15	0.12
Part 3	2.99	0.08

Statics (*n*=15)

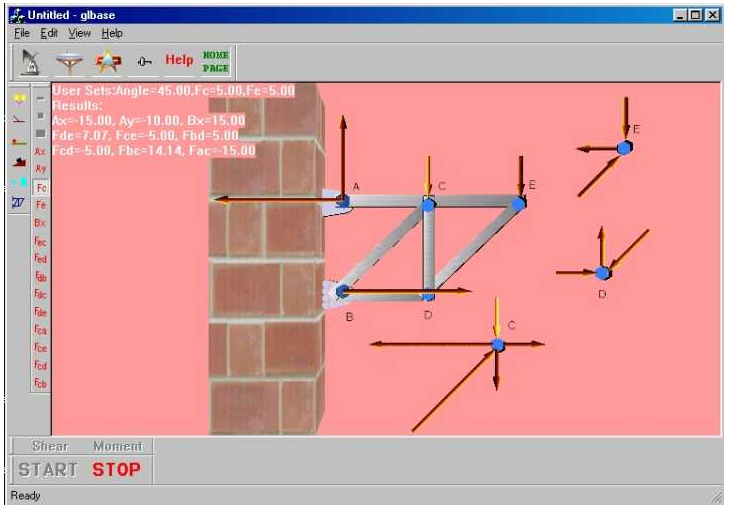
Section	Mean	Standard Deviation
Part 1	3.53	0.16
Part 2	3.37	0.20
Part 3	3.23	0.35

Dynamics (*n*=21)

Section	Mean	Standard Deviation
Part 1	3.37	0.29
Part 2	3.26	0.19
Part 3	2.91	0.32

Commercialization

- National Engineering/Physics Publishing Company: CD Format.
- Learning Effectiveness and External Evaluations Crucial to Commercialization Efforts.
- Ohio University Technology Transfer Office & Innovation Center will assist in commercialization, including seeking additional private and industrial funding.
- Goal: self-sustaining products in future.
- We are soliciting partners for independent evaluations of our products.



Project References

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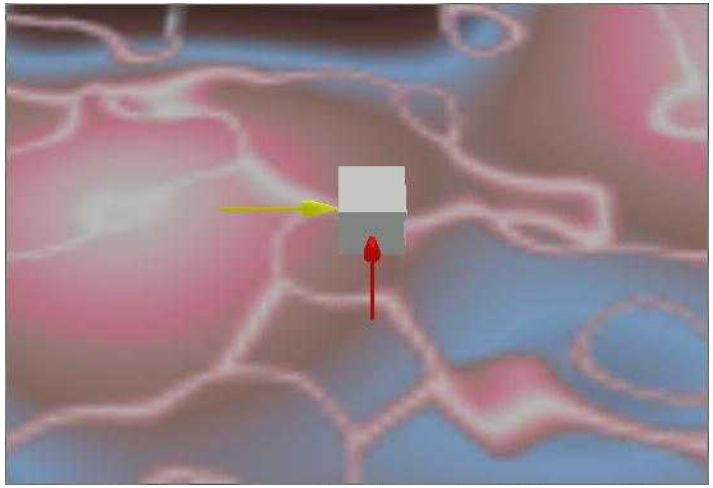
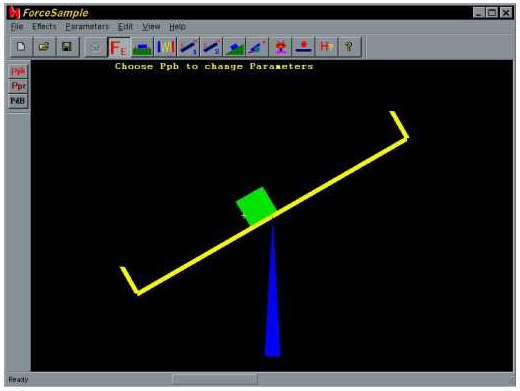
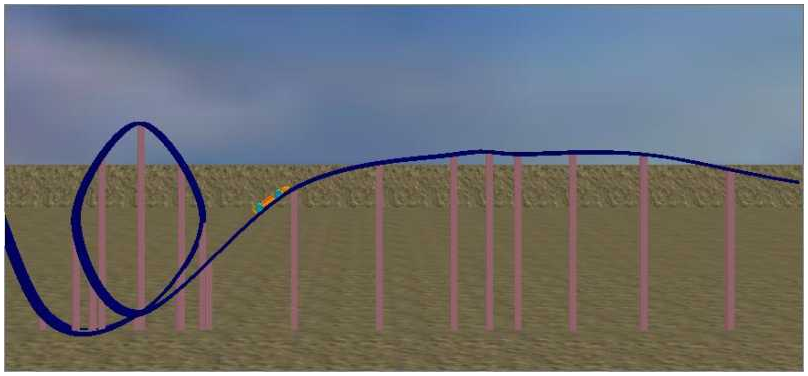


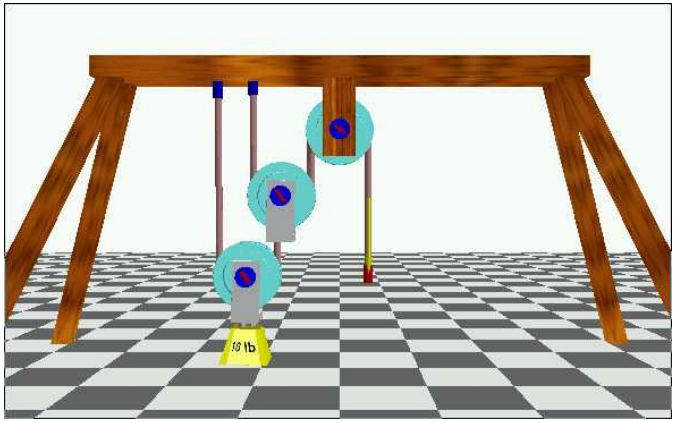
Related Projects



High School Physics (NASA)



Middle School Pre-Physics (NASA)



Elementary School Simple Machines (NASA)

Virtual Haptic Back (Osteopathic Heritage Foundation)

Acknowledgement

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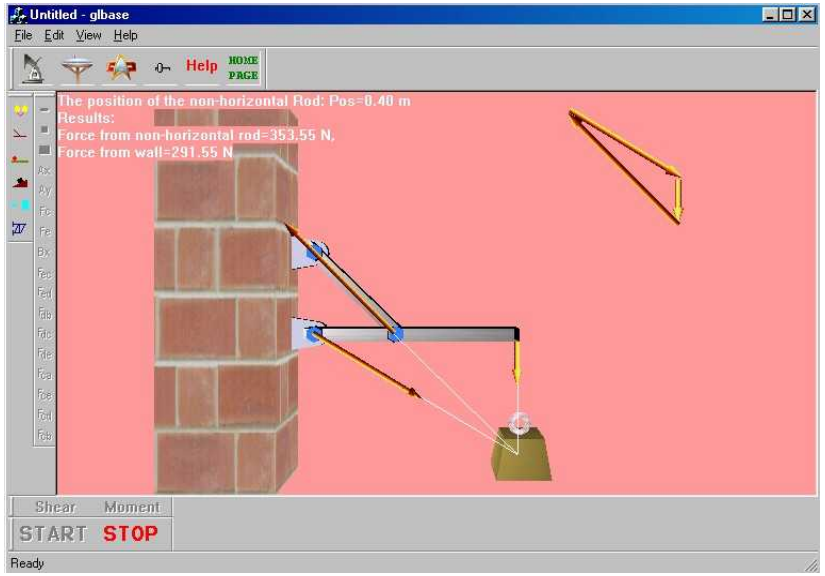
Conclusion

- Novel Augmentation for UG Engineering Education
- *Feeling is Believing*
- Deeper Understanding, More Engaging, Better Retention
- Proof-of-Concept Project Evaluations Promising
- Commercialization – Evaluators Solicited!



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