Conrad M. Zapanta
Teaching Professor & Associate Department Head
Biomedical Engineering

Wayne C. Chung
Associate Professor and Product Design
Program Chair in the School of Design

Joanna Dickert
Assistant Director of Undergraduate
Research and National Fellowships
Undergraduate Research Office

TEACHING & LEARNING SUMMIT 2016

Carnegie Mellon University

Cross-Disciplinary Design Teams for Biomedical Engineering Design

Novelty

- Historical precedence and leaders in the medical device industry have shown that blended project teams of individuals who have competence in their own discipline and are willing to work together towards a common goal, lead to creative and innovative solutions.
- Engineering students (Department of Biomedical Engineering) and product design students (School of Design)
  - Have educational experiences and skill sets that are significantly different
  - Results in two groups of undergraduate students who both think and work very differently

BME Design Class Format

- Two semester class based on Stanford Biodesign (1) curriculum
  - Fall: Form project teams, select and define project, create development plan, and complete initial prototype
  - Spring: Complete the plan that was developed in the fall semester
- Deliverables: Multiple prototypes, poster presentation and demo at design fair, and written report
- Projects selected from a prepared list, or from ideas generated by the students, industry, clinicians, faculty members, etc.
- Required class for BME students, elective for Product Design students

BME Design Teams

- Teams (4 to 5 students) formed using Comprehensive Assessment for Team-Member Effectiveness (CATME) system (2,3)
- Project preference, class schedule, primary engineering major, engineer/ product designer, software skills (MATLAB, solid modeling, etc.), leadership styles, big-pictures/detail oriented preferences, course schedule
- Diversity promotes multi-disciplinary collaboration and cooperative learning
- Not all teams will have a product design major
- Each team has "embedded" TA
- Peer evaluation was performed using CATME
  - Uses peer evaluation data and self-evaluations to assess how effectively each team member contributes to the team
  - Gives feedback to team members and to the person administering the teams
  - Areas evaluated
    - ➢ Contributing to the team's work
    - ➢ Interacting with teammates
    - ➢ Keeping the team on track
    - ➢ Expecting quality
    - ➢ Having relevant knowledge skills and abilities
    - ➢ Team conflict
- Classroom Undergraduate Research Experience Survey (CURE) used to measure student experiences in written and oral communication (4)
- University Research Office (URO) staff members participated in designated course meetings, providing course-specific guidance relative to proposal writing and project presentations.

Results

- Number of teams with Product Design majors has increased from 6.25% (1 out of 16 teams) in 2012 to 2013 to 75% (8 out of 12 teams) in the 2015 to 2016 year
- CATME results and student comments show that interdisciplinary teams with Product Design and Engineering majors generally have higher satisfaction than those teams composed of only engineers
- CURE results show that students in all groups had average gains in written and oral communication above average gains in their abilities to write a research proposal, present results orally, present results in written papers or reports, present posters, and critique the work of other students
- Several interdisciplinary teams have won design awards and have continued commercial development of design projects after completion of course

Future work

- "Product Design boot camp" to introduce engineers on design thinking and making
- Add product design "consultant" to help teams that don't have product designers
- Further analyze CATME evaluations to determine what specific factors are found among teams that have "success"
- Interdisciplinary clinical immersion in the summer

Acknowledgements

References

1. Yock P, Zenios S, Makower J, Brinton TJ, Kumar UN, Watkins FTJ, Denend L, Krummel TM, and CQ Kurihara (2015). Biodesign: The Process of Innovating Medical Technologies, 2nd Edition. Cambridge University Press: New York.
2. Loughry, M. L., Ohland, M. L., & Woehr, D. J. (2014). Assessing teamwork skills for assurance of learning using CATME Team Tools. Journal of Marketing Education, 36(1), 5-19.
3. Ohland, M.W., Loughry, M.L., Woehr, D.J., Finelli, C.J., Bullard, L.G., Felder, R.M., Layton, R.A., Pomeranz, H.R., & Schmucker, D.G. (2012). The Comprehensive Assessment of Team Member Effectiveness: Development of a Behaviorally Anchored Rating Scale for Self and Peer Evaluation. Academy of Management Learning & Education, 11 (4), 609-630.
4. Denofrio, L.A., Russell, B., Lopatto, D., & Lu, Y. (2007). Linking student interests to science curricula. Science, 318, 1872-1873.
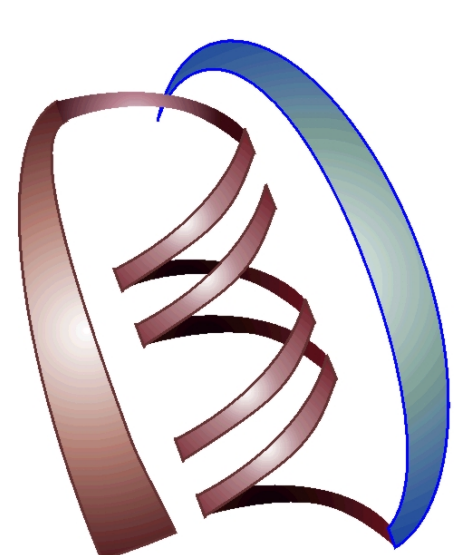
People Prop: a Back Brace for Camptocormia

M.I.A. Assisted Inhaler
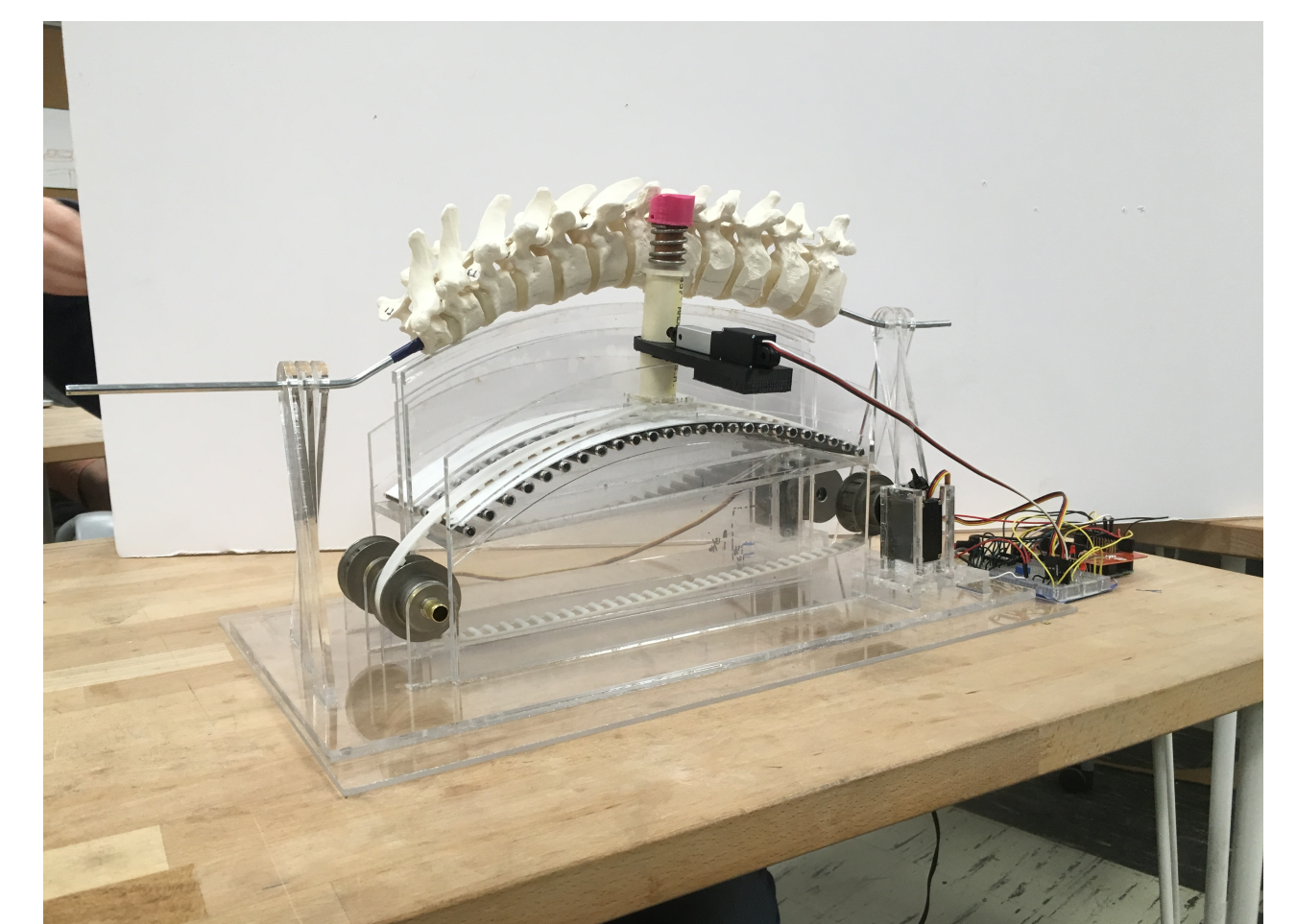
ChiroProktor: A Spinal Misalignment Simulator to Aid Chiropractic Adjustments

BIOMEDICAL ENGINEERING
Carnegie Mellon University

Carnegie Mellon Design

URO