Infant Rehabilitation Robot

Kira Cattell, Spencer Frey, Ryan Lee, Harrison Shen, Joseph Villalovos

UC SANTA BARBARA College of Engineering

nes+ *The safer, smarter crib.*

Background

Cerebral Palsy (CP) is a loss or impairment of motor function caused by brain damage occurring before the age of 2. CP is the most common motor disability in childhood, affecting nearly **4 in every 1000** children.

At ages of **3 to 9 months**, an infant's neural pathways change and develop at a higher rate - this is referred to as neuroplasticity. Studies show increased physical therapy treatment during this period can greatly improve mobility development. However, therapy is not always readily accessible.

Overview

Figure 1: Finished nes+

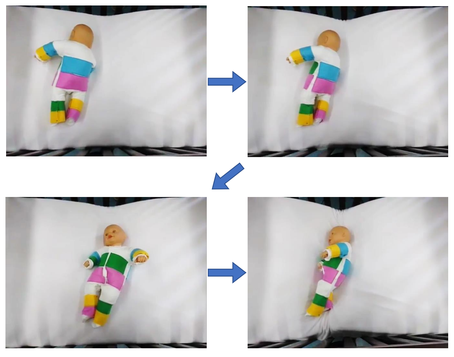
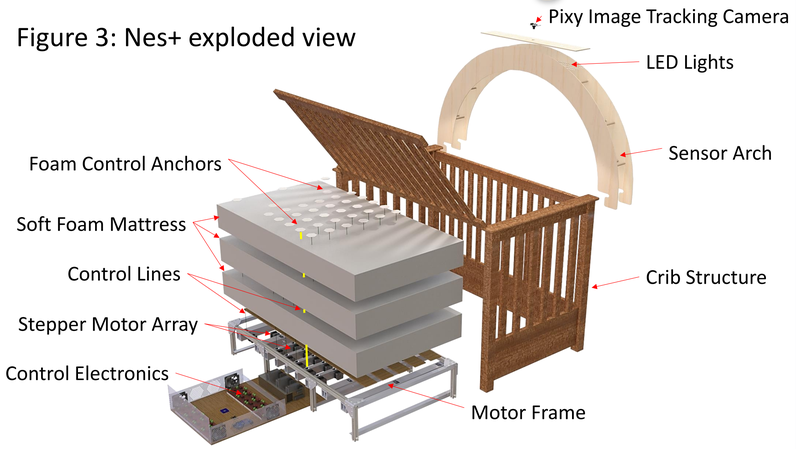


Figure 2: Rolling baby

Nes+ is a therapeutic crib that incorporates motion tracking and a supportive robotic actuated surface that generates 3-D shapes to assist in the development of neuromuscular control for infants at risk of diagnosis with cerebral palsy. By assisting motion during development of physical strength and motor control during the period of increased neuroplasticity, we hope to abate symptoms of CP in children later on in life.

Nes+ Design

Figure 3: Nes+ exploded view



- Pixy image tracking system with LED lighting to monitor infant posture in varied lighting conditions
- Soft 3-layer foam mattress provides breathable and flexible surface for therapy
- Motor array allows for fine control of baby's position and posture in crib

Design Analysis

Rolling takes the largest displacement and control. How much:

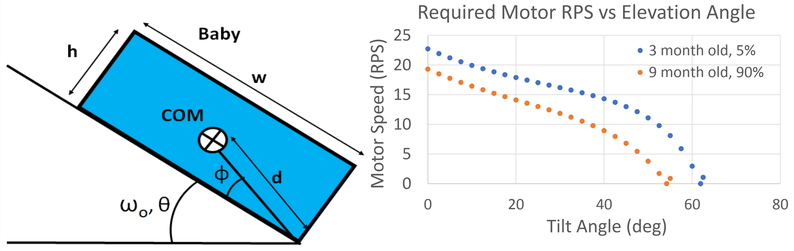


Figure 4: Rolling model and results showing possible rolls at varying speed

- Assuming baby is roughly rectangular with centered COM
- By conservation of energy, infant rolls on a 65° slope
- With 4" spacing of control points 65° is 8.5"
- Nes+ has 1.5 factor of safety, capable of 12 ±.1" displacement at 1 in/s. Roll is achievable in 8.5s

Testing & Results

Engineering Characteristics	Target Specification	Ideal Specification	Actual Specification
Max. Change in vertical displacement	11 in	11 in	**12 in**
Resolution of center placement	8 in x 8 in	4 in x 4 in	**4.4 in x 4 in**
Resolution of motion tracking	3 in x 3 in	1 in x 1 in	**0.75 in x 0.75 in**
Max infant size	20 in	28 in	**26 in**
Reachable pinch points & sharp edges	0	0	**0**

Figure 5: Functional prototype features

- Satisfied 3 out of 5 target specifications
- Maximum displacement and motor speeds were both sufficient enough to roll baby over
- Motion tracker can track colored onesie with good predictability

Next Steps

- Achieve greater range of motion
- Comprehensive integration of motion tracking and actuation
- Connect to web dashboard and mobile app for data, control, safety, and live monitoring for parents and doctor
- Further safety analysis
- Start medical trials

Lab D4H

Acknowledgements: Prof. Elliot Hawkes, Prof. Tyler Susko, Dr. Trevor Marks, Prof. Dave Bothman, Roger Green, Prof. Steve Laguette, Andy Weinberg, Matt de Vogelaere, Erinn Sloan, Madeline Dippel, Steven Landis, CCS San Mateo