Elephant Activity Anklet Integration: Research of past projects and compression testing methods

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Group 20
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Background

This research paper examines previous/existing elephant collars and anklets (focusing on the design and materials used in conjunction) and how other engineers tested the compressive strength of their design. In order to fabricate our components in a time-efficient manner and to make sure everything runs smoothly, it is crucial that we look into existing elephant collars and anklets; understanding the techniques, methods, and systems that other researchers have executed will benefit us to see what works best (and what does not work). Additionally, researching previous projects can also give us options on how we can run our risk reduction test (how we can test the strength of our component).

Research and Findings

To carry out research on these topics, I refer to the articles presented on pages 6-20. The first research article experiments with a designed anklet for elephants, using a leather strap and an OtterBox to house the accelerometer[1]. Because this design implements a purchased enclosure, there is no information on how it is tested for strength. Additionally, the discussion does not present any error analysis based on the design, which may show the design in this experiment was successful and allows us to consider this design as an option.

While there were many articles on elephant tracking devices, each, like this first article, did not provide much details (if any) on the materials of the sensor enclosure but rather the results collected from sensors/accelerometers. However, I did find one article testing elephant GPS collars at Disney's Animal Kingdom that somewhat explained the materials used for the enclosure[2]; they state that they use metal, water-tight, rectangular (box-like) enclosures and firehose material for the collar. Additionally, they weighed the entire assembly (collar, enclosure, and sensor) between 4.0 and 4.5 kg.

The final research article I found focuses on the behavior of a polymeric enclosure, explaining how they tested the compressive strength of the material[3] to find ways to test our enclosure for compressive strength. They tested their material using varying stress rates and temperatures using an INSTRON machine and a Split Hopkinson Pressure Bar, which can give us the insight to test our material.

Research on these topics output a potential dependable method of testing (which can be of use since UCSD obtains INSTRON machines), as well as designs and some materials that we may take into consideration. Using these research topics can guide us into the right direction and allow us to compare designs/materials used through FEA and find the best option.

Research Approaches

When searching for previous, successful projects of the elephant collar and anklet, I used the search engine Google Scholar, inputting phrases: a) elephant accelerometer; b) elephant anklet; and c) elephant collar. Because none of the articles associated with these output testing methods, I also searched “compression test of enclosure” and found great results. The three research articles I found output the most relevant results, however, I listed additional research articles in the appendix that helped me during my research; many of these research articles did not give me the information I needed but gave useful information and visuals. One of the articles implemented a sensor enclosure onto a turtle[4], while the other showed an elephant collar using an enclosure made by a company that designed collars by request[5].

Because UCSD has INSTRON Universal Testing Machines, I reached out to Professor Nicholas Boechler and his TAs in order to see if we would be able to utilize these machines for testing. I explained to them the purpose of our project, goals for compressive testing, and the dimensions of the component we would test. Professor Boechler allowed us to use this machine with the assistance of one of his TAs, Ethan Brothers. After teaching us how to use the machine for compressive forces, we now have a dependable method for compressive testing, which is a crucial to determine the strength it can withstand (in case the elephant steps on the enclosure).

Appendix

[1] Holdgate, Matthew R., et al. "Walking Behavior of Zoo Elephants: Associations between GPS-Measured Daily Walking Distances and Environmental Factors, Social Factors, and Welfare Indicators." *PLOS ONE*, vol. 11, no. 7, 2016, https://doi.org/10.1371/journal.pone.0150331.

[2] Leighty, Katherine A, et al. "GPS Determination of WalkingRates in Captive African Elephants(Loxodonta Africana)." *Wiley Online Library*, May 2008, https://onlinelibrary.wiley.com/doi/epdf/10.1002/zoo.20199.

[3] Singh, R., et al. "Optimizing the Design and Impact Behavior of a Polymeric Enclosure." *Materials & Design*, vol. 27, no. 10, 2006, pp. 955–967., https://doi.org/10.1016/j.matdes.2005.02.019.

[4] BRATUŠ, Blaž. "Development of the Waterproof Enclosure for Tracking System Pitstop." *University of Maribor Faculty of Mechanical Engineering*, Sept. 2018.

[5] Pastorini, Jennifer, et al. "Elephant GPS Tracking Collars: Is There a Best?" *Zurich Open Repository and Archive*, 2015, https://doi.org/https://doi.org/10.5167/uzh-123383.