

ASC 2023 Simulation Design Challenge

Design a manufacturable composite sling-less catapult arm to launch a blueberry.

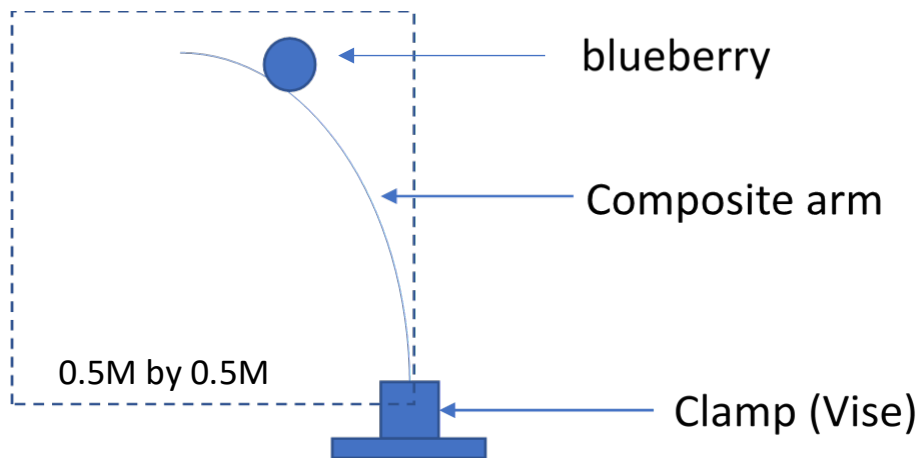


Figure 1. Schematics of the arm and

Goal: Virtually design an arm with maximum energy storage capability, release velocity and optimal launch angle to achieve the longest flight path for the blueberry. Any combination of additive or subtractive technology for nonmetallic composite materials can be used. The design must be optimal in the sense of minimum material use (weight) but have a factor of safety 1.2 built in with respect to the ratio of the maximum strain at failure to that in the operating regime.

Design constraints: Maximum operating envelope does not exceed 0.5M by 0.5M, the width should not exceed 30mm

Suggested mounting is a standard vise attached to lab table. An example of the blueberry mount is a circular hole of appropriate diameter.

An instrumented hand operated loading mechanism is encouraged. As a safety feature no hand contact with composite during launch is permitted (use a rope, etc.). If the arm breaks during launch it will lead to disqualification.

What to submit before noon on 09/18/2023

- 1) Pledge statement (required)

- 2) Calculation of the ratio of the work required to load the arm in J to the mass of the arm in grams.
 - 25 points maximum. The team with the highest ratio gets 25 points, the second, third, etc. receive 20, 15, ... (five-point reduction)
- 3) Simulation of dynamic performance, including the blueberry flight trajectory in the vacuum (10 bonus points for considering atmosphere). This calculation should include the blueberry exit velocity and the launch angle. 25 points maximum.
- 4) Calculate the factor of safety. The calculation should identify the location and the failure mode. 25 points maximum.
- 5) Detailed manufacturing specifications, including raw materials and final dimensions and any cure specifications if required. The calculation of the mass of the arm is required. 25 points maximum.
- 6) 25 bonus (max) points for building the arm and demonstration. A video demonstration will be accepted. The video must allow to clearly judge the dimensions of the arm and launch distance. The loading procedure should be clearly visible and feature one or more of the team participants present at the ASC. Should you wish to bring and demonstrate the catapult, please contact endel.iarve@uta.edu. You can later change your mind and submit the video or not submit any demonstration at all.

Total maximum: 100 points + 35 bonus points

How to submit:

Zip everything, name the file LeadersLastname_Insitution.zip (e.g. smith_mit.zip) and

- 7) Email (if possible < 20 MB): endel.iarve@uta.edu
- 8) Put your video/animation in Google drive, Drop box or any other file sharing website and email link to endel.iarve@uta.edu
- 9) If needed email endel.iarve@uta.edu and I will arrange for drop site. Use “ASC2023 challenge” as a subject line

What to bring for the demonstration if you choose so. Advanced notification is appreciated. Please email endel.iarve@uta.edu a week in advance (09/12/2023)

- 1) Composite arm assembly
- 2) Instrumentation for drawback/loading calibration
- 3) You will be allowed a total of 4 shots
- 4) Only the mass of the arm will be counted and not the additional instrumentation for load calibration (unless an integral part of the arm)

What will be provided if demonstrating on-site

- 1) Table and vise
- 2) Standard pack of fresh blueberries where you can pick your choice. You can bring your own unfrozen unmodified fresh blueberries.
- 3) Safety glasses (you welcome to bring your own)