Engineering Requirements

1. Dimensional Requirements
    a. Design Link: The frame of the bot will be constructed as a single body to maintain a maximum width, length, and height of 2.5cm. The interior of the frame will be compartmentalized to each additional component reducing any unnecessary weight. Each compartment will secure the electronics and power train components and allow for contractions at the expected deflection length.
    b. Testing Procedure: The 3D printed frame allows for an accuracy of up to one-tenth of a millimeter. This relative precision will expedite the manufacturing time necessary and produce a frame consisting of maximum allowable dimensions. To ensure the accuracy of the dimensions each new model will be physically measured.

2. Failure Analysis
    a. Design Link: The frame will be subjected to computer simulation and real scale physical simulation. By assuming a maximum applied force, the SumoBot will be tested to ensure that throughout preliminary electronic testing and final competition components will not fail.
    b. Target Procedure: By 3D printing the frame at its final dimensions and maximum mass the integrity of the structure can be experimentally tested to ensure adequate resistance to failure.
3. Maximize Thrust
    a. Design Link: Evaluate the thrust produced and consider the following design aspects; adding a low ratio gear train, and using different wheel diameters. Each aspect is primarily responsible for increasing torque- the driving proponent behind thrust.
    b. Testing Procedure: Calculated iterations for the different aspects proposed will yield theoretical values for applied thrust and supply our team with tangible proof of optimum performance parameters.

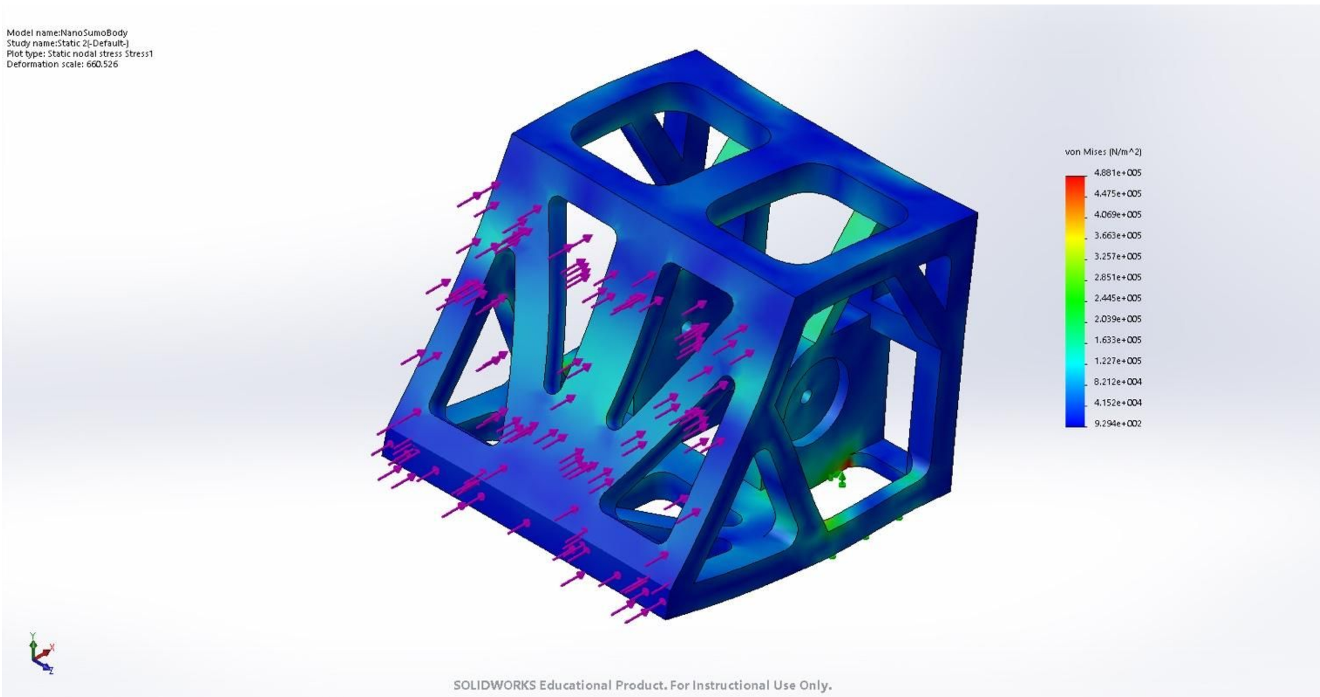
4. Autonomous
    a. Design Link: Autonomous navigation is crucial to the competition-as not achieving independent navigation will result in an automatic disqualification. To reduce mass the electronics involved will be simplified slightly. By “Bootlegging” onto a stand alone ATMega328 8-bit microcontroller we will be able to burn Arduino functionality onto the much small processor. While reducing weight this configuration also reduces optional inputs placing more stress on the command code.
    b. Target procedure: To achieve Arduino capability on a the 328 processor we plan to test numerous configurations utilizing a simple breadboard once we have achieved adequate results we will permanently attach the newly scripted 328 processor.
5. Actively Pursue Opponent
    a. Design Link: As the maximum thrust is so limited due to the weight restrictions,

the algorithm used to form the autonomous command code needs to be a practical approach while combating the uncertainty of the opponent's movement. Circumnavigating techniques yielded the best results gathered from research. The SumoBot will attempt to continuously track the opponent while traveling around the perimeter of the ring in shorter successive loops.

b. Target procedure: To ensure desired execution of this algorithm the fully assembled SumoBot will be tested in mock competitions. In these trials the SumoBot will have to execute the command code and respond to changing environmental conditions. These conditions will start simply with a static object and become more challenging as our command code adapts to inevitable issues. The final stage o0f testing will include a small RC car to simulate an independently controlled object similar to the final competition.

Design Rationale

The selected SumoBot design maximizes the space available wile maintaining adequate structural integrity. Each component has a predetermined housing within the structure which reduces the need to add any mounting hardware and allows for an intentional redistribution of the center of gravity. Two drive motors mounted towards the rear will provide ample torque and maneuverability which is crucial for navigating small areas such as the ring. There will be a total of three wheels on the SumoBot; two to provide thrust and steering and a spherical caster located under the front scoop to support imparted loads and reduce friction between the frame and the ring. For interoperating the environment, two IR detectors will be housed in the top face of the front scoop offset from the surface to prevent damage. For this design we will rely heavily on our coded algorithm as the simplified electronics will function in real time and contain little supervisory input. Ultimately, this design has been a result of distilling down more indicate designs and allows for significant weight reduction which led to; higher torque/weight motors, and larger pushing capabilities. The following images show fully dimensioned drawings and failure simulations for the frame.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Study name:Static 2(-Default-)
Plot type: Static nodal stress Stress1
Deformation scale: 660.526
von Mises (N/m^2)
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4.475e+005
4.069e+005
3.663e+005
3.257e+005
2.851e+005
2.445e+005
2.039e+005
1.633e+005
1.227e+005
8.212e+004
4.152e+004
9.294e+002
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Proposed Design

The nano SumoBot proposed design will drastically reduce manufacturing time thanks to 3D printers. The bulk of the structural and mechanical components will be printed CAD files that are not only light and inexpensive, but precise. The first few models we will produce will be primarily be aimed at fine tuning electronics and as such will be on a slightly larger scale. After testing and debugging the final dimensional model will be assembled and implemented. The resources needed to produce the design is fairly straight forward. We will use the NAU MakerLab to produce various parts, the fabrication lab for press-fit connections and possibly the Tormach CNC. The bill of materials for the design is listed in appendix BLANK and breaks down the expected total for each individual part.

Category	Part	Supplier	Description	Qty	Price/Piece	Total Price
Competion			3kg (r/c) Entry Fee	1	55	
Competion			3kg (auto) Entry Fee	1	55	
Competion			25g (auto) Entry Fee	1	55	
Competion			Bartending Entry Fee	1	25	
Electronics	Arduino Uno	N/A	Microcontroller	1	N/A	N/A
Electronics	Atmega328	digikey.com	8-bit Microcontroller	1	3.8	3.8
Electronics	Breadboard, General Purpose Plated Through Hole	digikey.com	Bread Board	3	3	9
Electronics	Optical Sensor 4 ~ 30cm Analog Output	digikey.com	Sensor	2	8.98	17.96
Electronics	Zinc Battery Non-Rechargeable (Primary) 1.4V Button, 7.9mm	digikey.com	Batteries	4	13	52
Electronics	Tactile Switch SPST-NO Top Actuated Surface Mount	digikey.com	Tactile Switch	10	0.16	1.6
Electronics	Miscelanious(3 wire harness, solder, LEDs, jumper wires)	digikey.com	Misc	1	30	30
Electronics	6mm DC Gearmotor- 19mm type	precisionmicrodrive.com	DC Motors	2	12.42	24.84
Mechanics	Bearing-Steel, Hardened Ball, 1.5 mm Diameter	mcmastercarr.com	Caster	100	0.0634	6.34
Mechanics	Plastic Gear - 14-1/2 PA, Press-Fit Mount, 48 Pitch, 12 Teeth	mcmastercarr.com	Power Train	4	7.5	30
Raw Materials	High-Strength Neoprene Sheet, 12" x 12", 1 mm Thick	mcmastercarr.com	12 inch length 5 mil	1	6.73	6.73
Raw Materials	3D Printed PLA(Frame, tires, mounting hardware)	NAU MakerLab	Frame components	50	0.1	5
					Total	187.27

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