Pumpkin Blast 2017
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Images courtesy of Alan Lowrey

This year Huntsville's annual Pumpkin Blast was held at Tate Farms on September 30. The Section's team, called the AIAA Pumpkinauts, consisted of four veteran team members from previous competition years and two new members. Team members included team captain Dylan Stapp, Adam Dziubanek, Brandon Stiltner, Daniel Coltey, Nathaniel Long, and Jonathan Bono. This year's competition was filled with much of the same excitement, drama, successes, and failures that have accompanied previous Pumpkin Blast efforts.

For those unfamiliar with Pumpkin Blast, it is similar to the national "Punkin Chunkin" competition, but on a smaller scale. Teams build machines of many varieties to launch pumpkins at targets (typically hay bales). Shots are scored by how close they land to the targets, which are positioned anywhere from 100-150 yards away. Shots that land within about five yards are given a score of 25 points while shots that fall within about 25 yards of the target can earn 10 points. A separate, bonus score of 25 points is awarded to the machine that can launch a pumpkin the farthest, and additional points may be awarded based on factors not related to performance (crowd votes for their favorite and a judge's award that is given to the team that "best embodies the Pumpkin Blast spirit". In previous competition years, the Section has performed well in the main, accuracy-based competition and has received the judge's award. Our objective this year was to bring a machine to the competition that could compete in the range category and give the team a shot at first place.

The team decided this year to reuse the same Fiffer trebuchet design from last year with some modifications. The veteran members of the team felt that the machine they had taken to competition last year exhibited the performance potential that we needed, but required some significant adjustments to avoid some of the failures from the previous year and draw the full potential out of the machine design.

The 2017 AIAA Pumpkinauts

One of the needed modifications was to reinforce the attachment of the throwing arm axel to the machine frame. It was at this attachment point that one of the legs snapped last year after a dry fire placed too much strain on the joint. Another weakness of last year's machine was the concrete counterweights. One of the sources of efficiency for a Fiffer trebuchet is that the counterweights fall vertically throughout the firing action, unlike a traditional trebuchet where the weights follow an arcing path. If a trebuchet is ideally weighted and tuned perfectly, the weights should nearly come to

a full stop just as the weights are nearing the bottom of travel, having transferred all of their energy to the projectile. However, tuning a trebuchet is a time-consuming task and is very difficult to get just right. Last year, the concrete weights were allowed to smash into the ground, which resulted in the destruction of several weights and would have ended the competition for AIAA's team if not for some quick thinking (and ratchet-straps). This year, our solution was effective, but a bit redundant. We manufactured enough concrete weights to replace the ones that broke last year plus another complete set, reinforced with small-gauge rebar so that we could afford to break a few. We also replaced the scissor mechanism's wooden members (that are the attachment from the weights to the throwing arm) with steel cables. This fix prevented us from having to worry about the scissor members breaking as they had done last year, and also allowed us to catch the weights before they hit the ground. Some additional reinforcement was added to the machine to handle the increased strain of catching the weights.

Other minor modifications were made to the machine, including using a high-strength sling made with straps instead of fabric, which had been the source of numerous failures last year. We also discussed replacing the hand-winch used to crank up the weights with an electric winch to make the arming process easier. However, we instead chose to add a large wooden cranking contraption to the hand-winch. This made cranking by hand easier, but was mostly valued for it's aesthetic appeal and the medieval feel of the cranking action as demonstrated by Adam Dziubanek in the following image.

Though we already had most of the hardware needed to build the machine from last year, there were still plenty of manufacturing challenges to overcome. Work was completed in about 5 weeks with a few late nights during the last week before competition. We were only able to get two test shots off the night before the competition, but testing did allow us to fix one cable-slipping problem that would have cost us time on competition day. The troublesome cables were a result of the added strain of catching the weights and were replaced with chains.

As the first shots of the official competition began, it was clear that we had built a competitive machine. Our team was the first to score points in the competition and was the first to get honed in on the target. Our rate of fire was significantly slower than some of our competitors, however, due to the hand crank. In fact, I am sure that we got the most exercise of any of the teams there between the hand-crank and the fifteen, 80lb concrete weights that we brought. Despite the slow rate of fire, our shots were accurate and we were throwing 5.5lb pumpkins compared to the 3.5 - 4.5lb pumpkins other teams were using (this is significant since heavier pumpkins score higher if a tie-breaker is needed).

Adam Dziubanek arming the machine using the hand-winch

The main, accuracy-based portion of the competition lasts for two hours. As the time ran on, our two primary competitors were eventually able to get their machines tuned after successive shots and began to rival us in accuracy. By the end of the two-hour

period, our team was slightly in the lead due to launching heavier pumpkins, but the scores were close enough that the final round, the long range shot, would decide the winner.

Up to this point in the competition, we had experienced essentially no mechanical failures, which was a big improvement over last year's performance. To prepare for the long-range shot, we added 160lbs to the counterweight and performed two practice shots. Our practice shots were reaching 165+ yards and we felt very confident heading into the final, tie-breaking round.

Just before the deciding shots were to be fired, we prepared the machine for the "all fire", which is a simultaneous firing of all machines for photo-op purposes. We chose to use this shot for additional long-range testing. As the countdown for the all-fire reached zero, our machines throwing arm whipped around much faster than usual. Our fears were confirmed as splinters filled the air around the machine and the would-be projectile pumpkin slowly rolled away from the machine's base. We had experienced a catastrophic dry-fire.

Through slow-motion video, we determined that the sling detaching too early from the throwing arm caused the dry-fire. When the firing cord was pulled, the machine shook slightly, but enough to cause the rope to fall off of the pin that was attaching it to the arm just before the arm whipped around. The damage was catastrophic. Two of the machine's legs were shattered in multiple places; the main axel was bent; and the barbell that held the weights was severely bent into a U-shape. Unfortunately we were not able to continue and received no points for the long distance shot.

In the end we took 3rd place in the competition about 25 points behind the leaders. We also won the crowd favorite award, in large part thanks to the social adeptness of Nathaniel Long, and got the chance to share our knowledge of trebuchets and the perks of being engineers with a lot of kids and families that were there to watch the competition. We were a little disappointed that our team didn't get to participate in the long shot, but were proud that our machine was in the lead heading into the last round and had a good chance of winning. After two years of failures due to dry-fires, we learned the lesson that we need to make more time to test the machine and design it to withstand dry fires. Altogether, the team had a great time building the machine and we achieved our goal of bringing the Section's most competitive machine to Pumpkin Blast.

The Fiffer trebuchet built by the team