PEAK OF FLIGHT NEWSLETTER

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PEAK OF FLIGHT

OSIRIS-REx and Other Great NARCON Presentations

By Bobby Potter

NARCON went all digital this year, which resulted in NARCON having the largest audience to date, and had a whole bunch of great presentations. These are available now to all event attendees on Accelevents, however they will become available to the general public in early March. You'll be able to find these on the NAR YouTube channel (https://www.youtube.com/channel/UCscXnrq6Hi9gT6ZMPw1mUeA).

First up was Bashar Rizk, the keynote speaker, who is a senior scientist on the OSIRIS-REx mission which just recently touched down on the asteroid Bennu and took a sample from the surface. This sample is currently on its way back to Earth, and Bashar gave us all an update on the mission.

Keynote - OSIRIS-REx

Bashar started with the always welcome news of probable mission success. It's not certain, as the sample is still years away from returning to Earth, but from all the evidence they collected it is most likely that the mission was a success.

To give context, the original mission objective of OSIRIS-REx mission was intended to take a sample from the asteroid Bennu, a rock body which is currently 328 million kilometers away, or approximately 204 million miles. The goal is to take a sample from the asteroid and send it back to Earth.

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FIGURE 1: OSIRIS-REX MISSION PRESENTATION

After quite some time in orbit around Bennu, just late last year they made the sample collection attempt. To collect this sample, they pressed an arm onto the surface of Bennu and released a bunch of gas onto the surface. This, in an environment with 5 micro G's of gravity, violently tossed a bunch of rock and particles into the "air". As the arm covered the entire surface where the gas was released, there was nowhere else for the rock and particles to go except into the collection chamber.

Although the mission itself took quite some time and will continue for at least the next 3 years, the actual touchdown itself was shorter than 14 seconds, and only the collection arm actually touched the surface. As soon as it did, it blew the nitrogen canister to collect the sample and then fired its thrusters to back away from the asteroid.

However, after the sample was collected there were some problems. The goal of the mission was to collect 60g of surface material. After blowing the nitrogen canister, they found they knocked up (and into the collection head) far more material than they originally expected to.

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FIGURE 2: THE TAG HEAD LOSING SAMPLE AFTER COLLECTION

That's great news, but there was one drawback. The nylon mesh system that was intended to secure the sample got blocked and held open by all the material they collected. This was causing the sample to not be secured, and to be leaking material into space.

This was complicated by the test they had planned to measure the amount of surface material they collected. They had intended to spin the head around and measure the radial inertia of the sample. However, without the mesh securing the sample, this would have almost certainly tossed a whole bunch of their sample into the vacuum of space just from the movement of the collection head. Instead, they stowed the head and started the sample on its journey back to Earth. This means they have no idea how much they collected, or even if the mission fulfilled its goal of 60g, however from pictures taken of the collection head it would appear they collected far more than they intended. Time will tell, as it will be years before that returns and we can evaluate and analyze the results.

This presentation was highly interesting, and well worth the watch for anyone interested in our current space operations.

Keynote - Sport Rocketry to SpaceX & Beyond

Steve Jurvetson is a long-time model rocketry hobbyist and venture capitalist that made early investments into SpaceX. This presentation discussed different projects he has been a part of, and the successes of the modern space industry.

A large portion of this presentation is in regards to business investments. He had a passion for rocketry, and a large portion of his time as a venture capitalist has been with endeavours in the space industry. For the first ten years of his career, not one business venture in the space industry met his criteria for a sound investment.

FIGURE 3: STEVE JURVETSON DISCUSSING HIS INVESTMENT IN SPACEX AND THEIR CURRENT OPERATIONS

Then he talks about how that changed in 2015. That year, just two companies received over a billion from venture capitalists, which was more than all investments into the private space industry up to that point combined, times 2.

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There is a lot to learn here, even for individuals who aren't going to be investing personally into the spaceflight industry. He talks about Moore's Law, and how the progression of computing constantly makes things possible that weren't possible before. Things that were required to be done a decade ago by trial and error can be done faster today with simulations, and without nearly the cost. The gaps in what is possible today that haven't been conquered are where the real investment value lies.

Rocket Motor Retention Systems

Then Michael Klett from Mad Cow Rocketry spoke on motor retention systems. This was a fairly basic outline of the different forms of motor retention that are commonly used in model rocketry, but he also goes over many of the options in the high-power arena.

These are things like the basic engine hooks, screw-on retainers, and the Mad Cow style of motor retention.

In addition to motor retention systems, Michael gives you a good overview of recovery wadding, dog barf, and other options for mid and high-power ejection events.

This presentation is a great resource for new hobbyists and for those looking at moving up their game from low-power to some of the more aggressive alternatives for larger rockets.

3D Printing - A Revolution in Amateur Rocketry

Ken Biba, a long time hobbyist and computer engineer, took some time to talk about 3D printing. This is a relatively new subject in the hobby, but access to 3D printers has been expanding rapidly over the last decade, and it already affects the way we build and buy things. Most university teams and TARC teams rely on 3D printers today, and we are likely to continue to see the expansion of 3D printing technologies in amateur rocketry.

FIGURE 4: KEN BIBA DISCUSSING HIS 3D PRINTING JOURNEY

This was a great presentation, specifically for the more experienced amateurs who haven't yet delved into the deep world of 3D printing. He went over the different types of 3D printers, how to use them most effectively, and the pros / cons of 3D printed components vs their "standard" counterparts.

I recommend this talk to anyone who is looking at starting to print their own components, as well as anyone who wants to learn the subject better than they know it now. Ken Biba certainly knows his stuff.

15k My Way

This presentation by Jim Jarvis details his construction and flight techniques for high-power rocketry. He covers electronics, building techniques, and recovery system setup.

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Jim is an impressive rocketeer, boasting flights above 100k feet on multiple occasions. There is a lot to learn from his experiences, and he does a good job walking you through the different methods he used to be certain his flight will achieve his goals.

How to Launch and Land a Model Rocket

For the last 6 years Joe Barnard has been developing advanced model rocketry systems with the goal of making an amateur rocket that is capable of propulsively landing (like the Falcon 9 does currently). His progress has been consistently incredible, first with thrust-vectoring systems and now to reaction control systems and propulsive landing.

FIGURE 5: JOE BARNARD SHOWING OFF HIS NEW PROPULSIVE LANDING FLIGHT COMPUTER DESIGN

Anyone who isn't familiar with BPS.space is going to want to see Joe and his presentation, but this presentation gets far more into the details than other things I have seen from him so far. He talks about the specific designs of his systems, how they function, how they are programmed, all of his data, and so much more.

Regardless of whether or not you are interested in making thrust-vectoring systems, this presentation is a must-watch.

LADCAP

The LADCAP stands for Launchable Automated Device for Collecting Airborne Particles. This device was developed by David Thomas, a professor who studies extreme environments as a proxy for potential life among the stars.

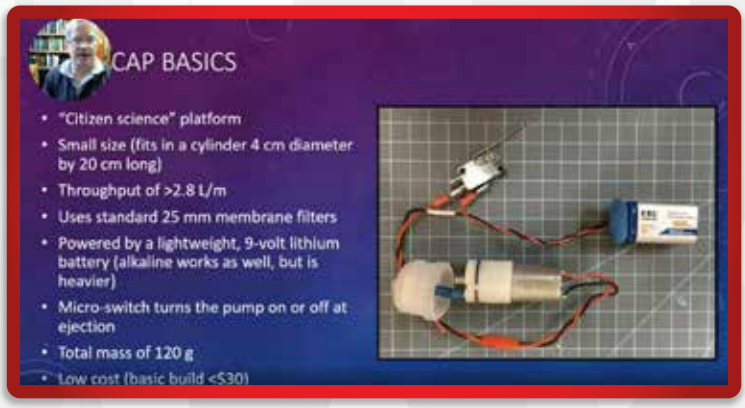

FIGURE 6: THE LADCAP DEVICE

We took notice of Dr. Thomas' LADCAP system quite some time ago, and have already done a bit of a deep dive (more than we would be able to fit in here) on the LADCAP device. It's a very interesting piece of equipment, with a ton of valuable uses, and it is easy to make one yourself! Take a look at Peak-of-Flight #526 (https://www.apogeerockets.com/education/downloads/Newsletter526.pdf) to learn more.

If you want to take a bit more of a look into this system than that article gives you, be sure to check out his presentation.

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Intro to Using Single Board Computers and Micro Controllers in Model Rocketry

Bruce Canino has been designing single board computers for his rockets for more than a decade, and came to NARCON this year to impart some of his knowledge. This was a presentation geared toward hobbyists without much electronic payload knowledge, and makes for a great way to get started on your own payload bays.

Bruce talks about the layout of electronics bays, the different components that might go onto a board or micro-controller, and where you should start if you want to get into making your own electronics.

Model Rocket Stability & Aerodynamic Equations

Jim Barrowman is a renowned figure in model rocketry, and for good reason. He originally submitted an R&D project to the National Association of Rocketry entitled "The Theoretical Prediction of the Center-of-Pressure," where he proposed a method to calculate the location of the center of pressure on a model rocket (or any rocket). This method was simple enough for any hobbyist, didn't require a wind-tunnel or computational fluid dynamics, and quickly became the most common way for rocketeers to determine the stability of their rocket. This paper is responsible for much of the safety record that the hobby touts to this day.

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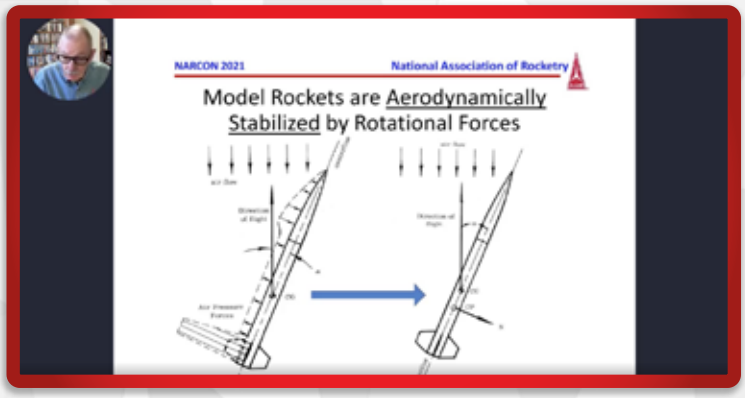

FIGURE 7: JIM BARROWMAN DISCUSSING STABILITY IN MODEL ROCKETRY

Jim Barrowman presented at NARCON this year, breaking down his original paper, and delving a bit deeper into the topic.

Though this paper is pretty regularly considered important reading, and you've at least read reiterations of the points covered when you first learned about stability, this presentation makes for a great alternative to learn this subject for those who prefer to learn from a presentation over reading his R&D paper.

GPS Systems for Sport Rockets

Will Marchant, an Aerospace Engineer with the University of California, Berkeley Space Sciences Laboratory, goes over the common GPS systems used with sport rocketry. In his presentation he discussed the benefits of GPS tracking, as well as the pros and cons of the widely available systems.

Additionally he covers the history of GPS and the limitations these systems have.

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Safety in High Power Rocketry

Trip Barber is the NAR's representative for the National Fire Protection Agency. He advocates on behalf of amateur rocketry and makes sure we are following the National Fire Protection Agency's rules and regulations.

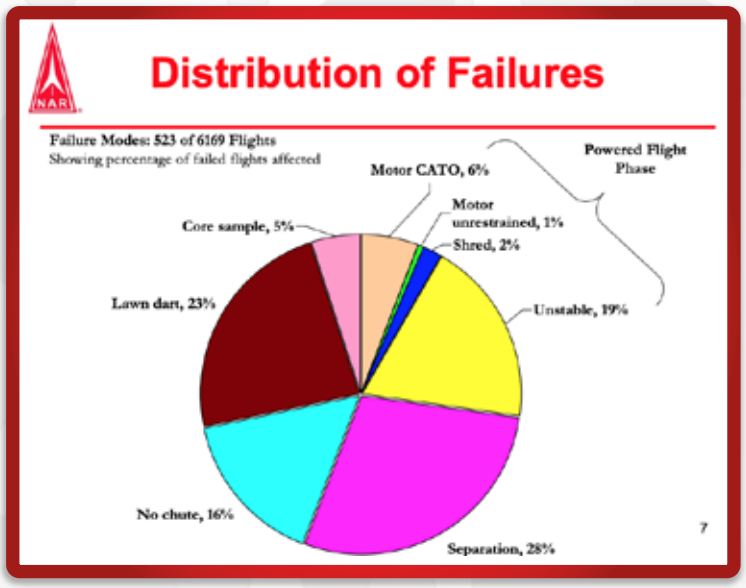

FIGURE 8: TRIP BARBER DISCUSSING THE TYPICAL FAILURES THAT OCCUR IN OUR HOBBY

Over this time, he has seen and reviewed everything, from ballistic returns to power-line disasters. In his presentation he reviews everything he knows about range set-up, range safety, and the potential disasters we are trying to avoid. This is a great presentation for anyone interested in flying model rockets, however could be considered essential for anyone who intends to run a launch site or operate as the launch safety officer.

Real Artists Steal: Simple Scale Techniques to Create Unique Sport Models

James Duffy came with a unique presentation this year, all about scale models. He covers model conversions, like turning an Estes Alpha into a P-51. He also breaks down many of the techniques he uses to create some of the most realistic and unique models on the range.

This presentation is jam-packed with finishing techniques and design. His approach is to take a regular sport model rocket, and using techniques from the scale modeling world, turn them into something truly unique.

You should watch this if you are looking at learning some new finishing techniques or some unique ways to make your "regular" model rocket into something truly unique.

Getting Unusual High-Power Rockets to Fly

Another amazing presentation, this time by Dave Schaefer. Dave is a pilot and engineer whose model designs can even be found at some flight museums. Dave has taken to large rocket-powered gliders, all custom made and of an awe-inspiring scale.

FIGURE 9: JUST A FEW OF DAVE'S MODELS

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In this presentation Dave details his design and testing methodologies, his construction process, and many of the pitfalls that can occur when you take on a project as complex as these can be. He also discusses data collection and how to analyze your results to make sure your full scale project goes exactly as planned.

Anyone looking to take on some really ambitious projects should watch this presentation, as Dave covers every base. In his own words “You should be able to take on a project like this with some degree of confidence using the methodology I’m going to show you here”.

The Design, Evolution and Production of Long-Burning Motors

Gary Rosenfield, the owner of Aerotech, took some time to talk about the new motors they are releasing. These are specifically long-burning motors, like the kind that thrust-vectoring systems would utilize to maintain a stable flight profile.

FIGURE 10: GARY ROSENFIELD DISCUSSING LONG BURN HIGH-POWER MOTORS

He discussed the testing process and evolution of long end-burning motors, as well as a comparison on the total impulse with that of the more traditional short-burn motors that we are all accustomed to. This presentation made for an interesting watch, and really gets into the details of motor design and production.

Fabrication of Lightweight Fiberglass Body Tubes

Terrill Willard breaks down his techniques for creating lightweight fiberglass airframes using a fiberglass weave, a mandrel, and some thin epoxy. These airframes can weigh less than half of their craft paper counterparts with far more strength.

Purpose built for competitions, this presentation is a must-see for anyone looking to grab a medal at a local or regional flight competition. These airframes can help you to maximize altitude or duration, while being much easier to construct than you might imagine.

Artemis Propulsion Systems - How the USA Gets Back to the Moon

Matt Steele gave us a great overview of the motor systems that will be used on the Space Launch System (SLS). He discussed the RS-25 engines, the RS-10, as well as the solid rocket boosters that will be used.

This is another great presentation on the current state-of-the-art technologies that NASA is using, and how the successes of the Space Shuttle are being reused in the new-age of the space race.

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Design of Large, Lightweight High Power Rockets

Frank Burke, the owner of Dynasoar Rocketry, discussed some of the best techniques and materials he has come across in his 45 years of hobbyist rocketry.

FIGURE 11: FRANK BURKE DISCUSSING SIMULATIONS OF LARGE HIGH-POWER ROCKETS

A decent part of this presentation is on minimizing the weight of your models, while maintaining a flight ready condition and strength. This presentation is great for experienced rocketeers looking to take their design and optimization to the next level.

NRC Boost Gliders, Robust and Reliable

Keith Vinyard, a long-time hobbyist with more than 45 years of experience, came to discuss rocket gliders and the methods you can use to build a strong, durable glider that will withstand hard landings and unfavorable conditions.

In this presentation, he advocates for a slightly heavier build than the ultra-lightweight alternatives that are usually preferred in competition. He details how to build a strong, robust glider that you can use many times over, collect data, and then iterate the design into something more competitive on launch day.

Anyone looking at getting into gliders or glider competitions should carefully review this presentation.

Sport Rocketry Dual Deployment

John Coker, one of my favorite hobbyists (because of all the knowledge he has already given me), came by to give an introduction to dual deployment. In this presentation he explains how they work, what the benefit is, and how you can design a dual-deployment system yourself.

FIGURE 12: JOHN COKER DISCUSSING EBAY CONSIDERATIONS

From this presentation you will get a good understanding of the electronics that John Coker uses himself. He'll also go over the best way to layout your system, and how to set up your system so that it is safe and reliable.

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Using Altimeters - It's easier than you think

Bernard Cawley gave a great introduction to altimeters at NARCON this year, a perfect place to start for anyone interested in joining the leagues of data-driven fliers.

In his presentation he went over the different ways to integrate altimeters into your rocket design, the different options approved by the NAR for competition, and all the current altimeter options and their respective trade-offs.

Finally, he goes over the data. There's a bit of an art to understanding your results, and implementing changes to maximize your results. This is where the real benefit to altimeters comes from, and his presentation will teach you the basics of understanding your data.

How to Win TARC

Pavel Pinkas has been coaching TARC teams for 17 years, and has brought many of those teams to victory. At NARCON this year, he talks about all the lessons learned, and the tips and tricks you can bring to your TARC team to increase your chances of success.

This is a great presentation for TARC mentors and students participating alike. Some of the tips and tricks here can only be acquired through many years of experience, and any new team entering the competition is going to want the leg up that this competition provides.

Summary

In addition to these great presentations, there were many facility and launch site tours, great social hours and Q&A sessions. NARCON this year had a wealth of knowledge on display, and the NAR is going to make all of these presentations available and free to the public in early March.

If you are reading this after March 2021, check out the NAR Youtube channel (https://www.youtube.com/channel/UCscXnrq6Hi9gT6ZMPw1mUeA) to see all these presentations in full.