ISSUE 100 - MAR. 21, 2003

APOGEE

PEAK OF FLIGHT

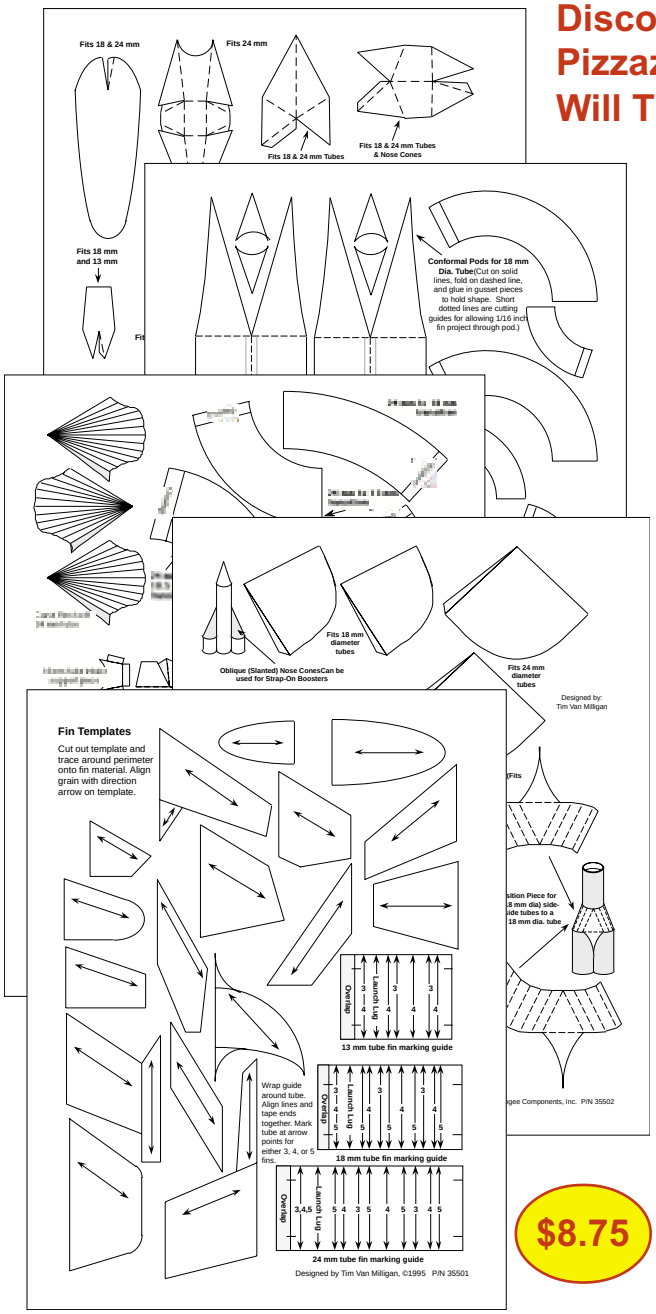
NEWSLETTER

Winners of the "Designer's Resource Pak" Contest

What Does "Rocket Science" Mean?

APOGEE COMPONENTS

1130 Elkton Drive, Suite A
Colorado Springs, CO 80907 USA
www.ApogeeRockets.com
orders @ApogeeRockets.com
phone 719-535-9335 fax 719-534-9050



Discover An Easy Way to Add Style and Pizzaz To Your Rockets — Other Modelers Will Think You're A Design Genius.

With the Designer's Resource Pak, you can give your rockets that uniquely distinct appeal that will make others envy you with jealousy. And it is easier than you think.

The Designer's Resource Pak is a collection of cardstock patterns and template sheets that you simply add to your rocket to give it a personalized stylistic appearance. They are different from anything ever before created, and you're sure to stand out from the crowd. The 5 sheet set includes: Fin Templates, Paper Canopy Patterns, Cardboard Nozzles, Paper Nose Cones, Inlet Ducts and MUCH MORE! Use these in various combinations to make hundreds of different rocket designs! There are enough parts to create an armada of distinctive rockets.

On these pattern sheets are:

- 17 Fin templates
- 15 Cardboard jet cockpits (all different types!)
- 12 Cardboard nozzles
- 5 Tube transition sections
- 4 Oblique nose cones (never before available)
- 3 Fin placement guides
- 3 Angled tube cutting guides (great for inlets)
- 3 Cone fins (really neat and ultra different!)
- 3 Jet intake pattern developments
- 2 Conformal fairing pods
- 2 Circle-to-square transition sections
- 2 Circle-to-triangle transition sections
- 2 Transition pieces for 2-tube cluster to a single tube
- 1 Circular intake cutting guide (ultra unique and exciting!)
- Instructions for enlarging any piece to fit any rocket

Also included: 7 different display stand patterns so you can show off your great looking rockets! Plus you get a SPECIAL FREE BONUS: Kit-like plans - the "Interstellar Crusader;" a futuristic NASA high-speed research plane. The sleek styling of this high-flying model will be the envy of all your rocket flying friends.

$8.75

Designer's Resource Pak

Order Now From The Apogee Web Site!
http://www.ApogeeRockets.com/construction_supplies.asp

Archives of this Newsletter

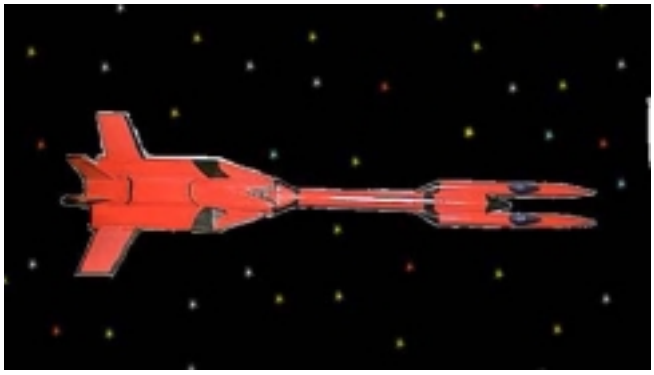
All the articles that have appeared in this newsletter are archived at http://www.apogeerockets.com/education/newsletter_archive.asp

Designer's Resource Pak Contest

Ferrell Wheeler - "Iceworld Explorer" - First Place

John Young - Second Place

Bob Ellis - Third Place


Marc Harris - "Thor's Anvil" - Honorable Mention

At the beginning of the year, Apogee Components ran a contest to promote new and interesting rockets using parts found in Apogee's Designer's Resource Pak (http://www.ApogeeComponents.com/construction_supplies.asp)

The purpose of the contest was to let people know how exciting the Designer's Resource Pak really is, because it allows you to create all types of really unique designs from simple templates and pattern sheets. To that end, I believe we succeeded. There were many unique looking models that were submitted that made judging this contest very difficult. That just proves there are a lot of innovative people out there among the readers of the Apogee e-zine newsletter.

There were 63 people that requested a FREE copy of the Designer's Resource Pak. Of those, we received 18 entries back. We knew there would be some people that were just out to test us; to see if I would really give away something for free. Even though we didn't get all the entries back, there were many excellent designs that were recieved.

The pictures here are the ones that I found most unique, which is why I've given them the recognition here:

First Prize: $75 Gift Certificate for Apogee merchandise.
Second Prize: $50 Gift Certificate for Apogee merchandise.
Third Prize: $25 Gift Certificate for Apogee merchandise.

If you would like to see the rest of the rockets that were submitted, you can see them at:
http://www.ApogeeComponents.com/designers_pak.asp

Morgan Lees - "Sharkroc" - Honorable Mention

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PEAK OF FLIGHT

It Is Rocket Science After All...

By Tim Van Milligan

what does the phrase "rocket science" mean?

Rocket science is generally meant to describe "knowing how your rocket will fly, long before you push the button to launch it into the air."

Rocket science becomes important because, as rockets get larger in size, their price tag also increases too. Therefore modelers want to assure themselves that the flight will be safe and successful; so that they aren't wasting money.

From the educational standpoint, whenever a student or a modeler gets involved in launching larger rockets, they have to learn more about how rockets operate.

Most rocketeers will spend a huge amount of time designing their perfect rocket. The reason is that they want to achieve the mission objectives of their flight. The same way that NASA wants to achieve their mission objectives when they launch a payload into space. If you don't meet those objectives, then the launch can be said to be a failure.

what are some mission objectives:

1. To fly as high as possible using the smallest (cheapest) rocket motor. This is something people like to do to see how efficient they can be. See the related article: http://www.apogeerockets.com/education/downloads/newsletter75.pdf

2. To carry some electronic payload, like an altimeter, pressure transducer, or camera into the air, and safely recover it intact.

Students and rocketry modelers are not terrorists. They want to get their rockets back to fly them again and again. The modeler wants to learn more about rocketry so that they can make their next model even better.

To that end, what do rocketeers want to know?

1. How high the rocket will fly?
2. How fast it will go?
3. Will it fly straight? Or will it go unstable?
4. How much electronic payload will the rocket be able to carry?
5. Are the fins strong enough to stay attached to the rocket at high speeds?
6. Where during the flight the parachute will be deployed? At peak altitude; or while the rocket is ascending or descending.
7. If the parachute is deployed while the rocket is still traveling forward, will the parachute be ripped to shreds by the opening forces?
8. Will the rocket descend slow enough that it won't be damaged on landing?
9. How far will the wind make the rocket drift?
10. How efficient is the design?
11. How will the flight path of the rocket be affected by the wind?
12. Will the parts of the rocket fit together? What parts will the user have to buy or make?

Image courtesy of Pratt Hobbies

how to answer these questions?

Model rocketry has undergone a similar history as that of NASA. In the 1950's and 1960's, most models were build using a "best guess" approach. The physical laws that governed how rockets operate were not really understood, and so there was a lot of experimentation.

But over the years, modelers have come to understand the laws of physics that dictate how a rocket works. They have made their flights significantly more safe, and successful. As a result, they have the confidence to build larger rockets that are just as safe as the smaller models.

One particular tool that has become indispensable to the modeler is the desktop computer. Like the work done by NASA, modelers are now designing their rockets on the com-

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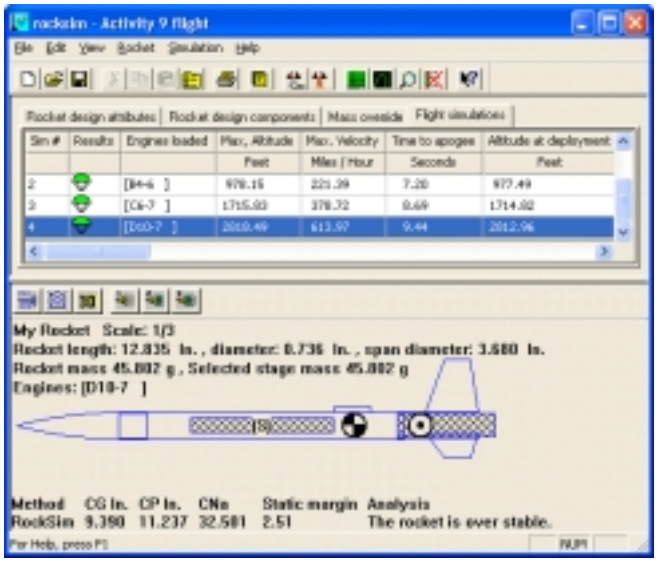
puter, and are running it through simulated launch scenarios. This allows them to optimize the design, and give them a strong indication of how it will behave when they actually build and launch it. Obviously, this makes the launch safer and increases the success rate of the flight.

At this point, I'll discuss some of the computer programs modelers use, and how it helps them to create and launch safe and successful rockets.

ROCKSIM

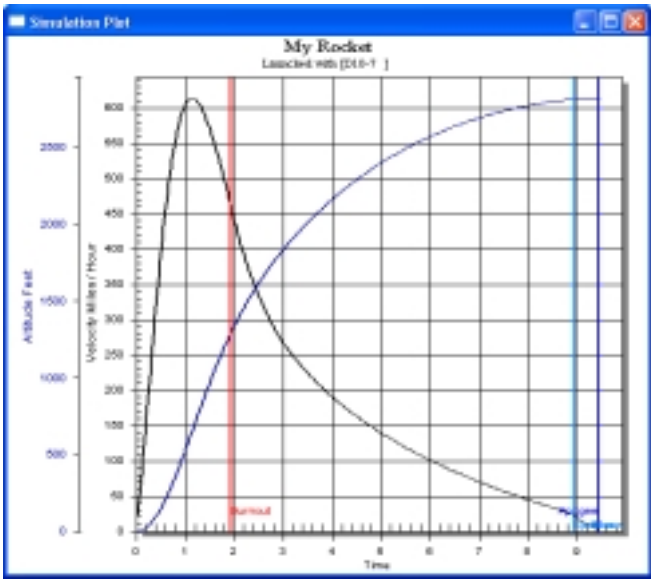
The RockSim software (http://www.ApogeeRockets.com/rocksim.asp) has been a tremendous help to modelers. It does two very sophisticated things. First, it allows the modeler to



ROCKSIM allows the modeler to design and simulate nearly any model rocket.

design their rocket. That means it allows them to select and arrange the parts to make sure everything fits together properly. While it does this, it is constantly checking to see if the design will fly straight and true. Second, once the design is finished, RockSim allows the user to simulate the flight using any rocket motors.

When we say a simulation of the flight, what we mean is that it will tell us information like: how high the rocket flies, plus other parameters like acceleration, velocity and downrange drift.One of the advanced features of RockSim is that it will tell the user how the rocket will react to a gust of wind during the flight. Will the rocket suddenly go unstable, will it



Both students and modelers find the plots created by RockSim to be an excellent aid in understanding "rocket science."

turn into the wind (called weathercocking), or will it simply blast through the gust like it wasn't even there. That is what makes RockSim so valuable to modelers, and increases the safety of every launch.

RockSim also has other features in it to allow the modeler to create templates and pattern sheets to make the construction of the model proceed faster and so the parts fit together with more precision.

It should be noted that every competitor in the Team America Challenge were required to provide a simulation analysis of their projects. The software they all used was RockSim. Besides allowing the students to design their rockets, it has become an excellent way to teach fundamental rocket science, enhance safety, and bring hours of enjoyment to avocational rocketeers as they perfect their designs.

As great as RockSim is, there are a few programs that can be used in conjunction with it that increases the effectiveness of the software and the safety of the flight.

FINSIM

Even though the modeler's design may be stable according to RockSim, this does not guarantee that the rocket is ready to be built. Ifyou don' t know how strongthe fins are, you'll either be launching an unsafe rocket, or one which is an overbuilt oaf that won't travel as high as the modeler would like. The FinSim software (http://www.apogeerockets.com/finsim.asp) will predict how strongthe fins are. More impor -

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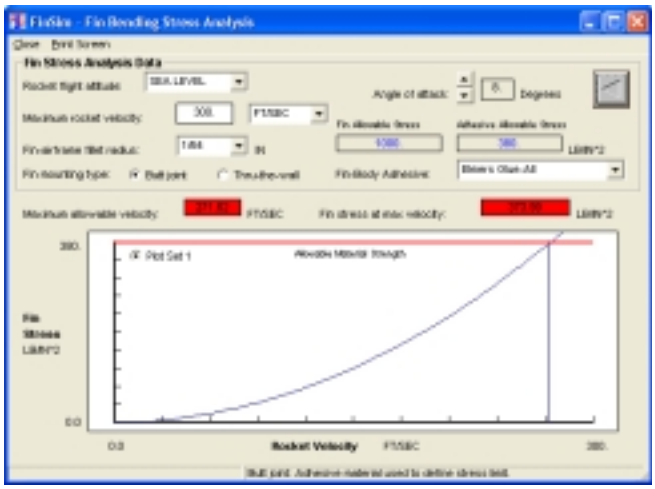


FinSim is used by modelers to find out how strong the rocket's fins need to be.

tantly, it tells you if they'll stay attached to the rocket under extreme flight loads of a wild flight. It can also tell you if the fins are too sturdy—meaning they are heavier and thicker than they actually need to be. If they are, you'll be loosing performance out of your rocket.

FinSim can also be used to design rockets that fly straighter if they use a technique called rifling. This means the rocket spins rapidly as it ascends into the air, like a bullet coming out of a rifle. The spinning motion cancels out unexpected disturbances in the flight, like a sudden gust of wind.

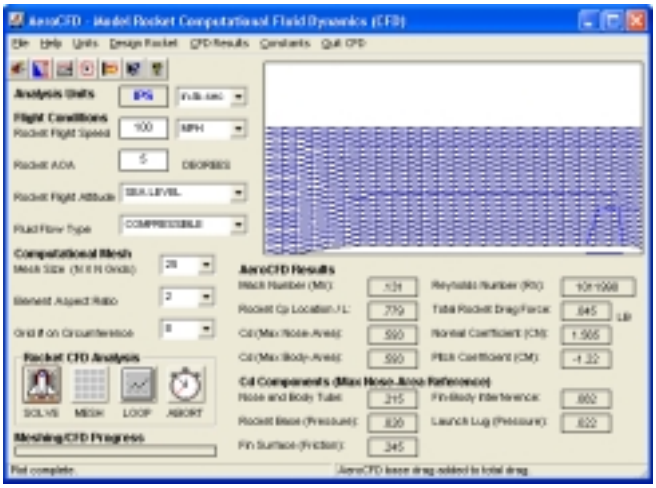
What FinSim does in this case is tells the modeler how fast the rocket will spin when they cant the fins, and how much more straight the rocket will fly as a result.

The downside of spinning the rocket is that it increases the drag forces on the fins, so the rocket doesn't fly as high as a non-spinning model. The other problem is that spinning puts extra stress on the fins, trying to tear them off the model. The program tells the modeler if they are strong enough for a spinning flight.

AeroCFD & HyperCFD

The RockSim program offers the modeler some sophisticated flight analysis. But that flight information is only as good as the information RockSim has about how the airflow over the rocket affects the model.

In recent years, new and more accurate ways of predicting the airflow over the rocket have come about. The new method is called "computational fluid dynamics (CFD). That is a fancy way of saying that computers are predicting the



AeroCFD and HyperCFD add increased accuracy to RockSim simulations

flow of air over the rocket, and determine what forces are created. Basically, it is like a wind tunnel inside a modeler's computer.

Two programs have been developed that offer the modeler an inexpensive way of getting highly accurate information about the forces acting on the rocket. They are AeroCFD (http://www.apogeerockets.com/aerocfd.asp) and HyperCFD (http://www.apogeerockets.com/hypercfd.asp). They are very similar, but AeroCFD determines the forces at subsonic speeds (below approximately 700 mph), while HyperCFD computes the forces at supersonic speeds and above.

As the rocket gets more complicated, there may be additional computer programs that the modeler might use too. Most

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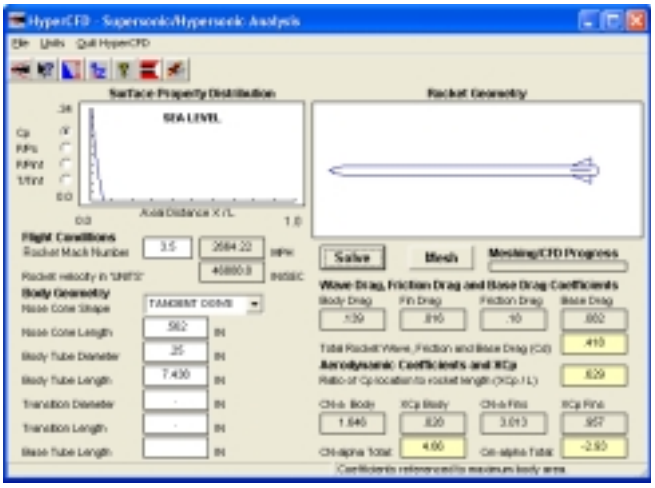

HyperCFD is used on models that fly at speeds greater than Mach 1.

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times, it is because the FAA wants to see where the rocket might land. So it is another safety level that has to be met.

conclusion

Drop by a modern rocket range, and it is not unusual to find relatively young children conversing with professional engineers about the pros and cons of different construction elements of their model rockets. Many educators feel this is a compelling reason to integrate rocketry into the curricular plan, to help show students the benefits of mathematics and physical science in real-world situations.

Rocketry, and the software described above, provides students and modelers with a exciting "hands-on" educational tool. It gives them a real-life example of the use of mathematics and computer science in a way that offers clear-cut proof of the validity of science; in a way that is fun.

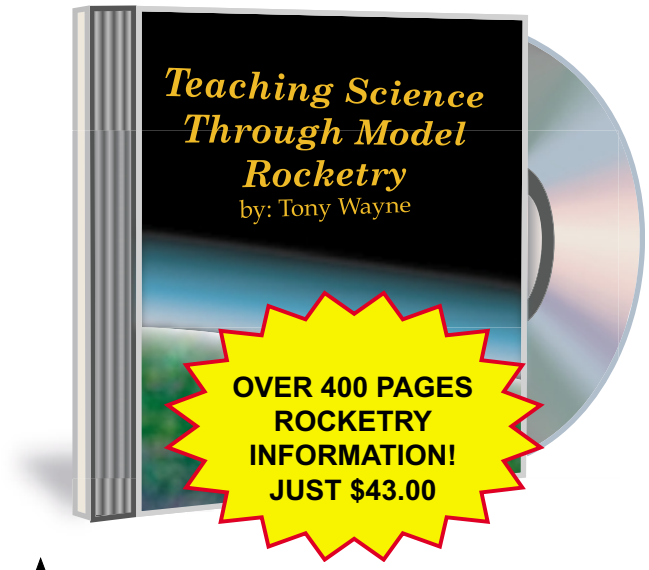
Our goal with this article was to show that students and modelers are using true "rocket science" techniques. What they are doing is very similar to what NASA does. They are designing and constructing rockets that are reliable and stable; which increases the safety of the rocket, as well as it's performance.

reprint information:

Tim Van Milligan is the owner of Apogee Components (http://www.apogeerockets.com) and the curator of the rocketry education web site: http://www.apogeerockets.com/education. He is also the author of the books: *Model Rocket Design and Construction, 69 Simple Science Fair Projects with Model Rockets: Aeronautics* and publisher of the FREE e-zine newsletter about model rockets. You can subscribe to the e-zine at the Apogee Components web site, or sending an email to: ezine@apogeerockets.com with "SUBSCRIBE" as the subject line of the message. This article may be reprinted as long as this paragraph is included with the text.

"Teaching Science Through Model Rocketry"

By Tony Wayne



This massive (400 pages) collection of information and experiments gives teachers the ideas you need to teach science with the excitement of rocket power.

You'll discover high-intensity demonstrations, activities, and research projects that are easy to perform:

- Detailed lesson plans using a "how-to" approach.
- 24 simple "magic trick-like" demonstrations.
- QuickTime™ videos and FLASH™ animations.
- Building Tips to help make better rockets.
- How to measure a rocket's altitude and liftoff velocity.
- 21 Rocketry labs you can perform.
- Overhead transparencies for your classroom.
- A list of 34 basic rocketry supplies.
- Five different launch controller plans
- How to use Apogees' RockSim design software in your rocketry unit. See a **FREE** sample of one of the Lesson Plans at: http://www.apogerockets.com/sample_lesson.asp
- Information that can be used in grades 6 and up.

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Media: This book comes on a CD-ROM that works on both Windows and Macintosh computers. Contains a collection of files that can be read with Adobe Acrobat Reader. The videos can be viewed with an internet browser like Netscape and Internet Explorer, or with a stand alone program like QuickTime viewer.

For more information, and to order your own copy, please visit:

http://www.ApogeeRockets.com/teaching_science.asp

or call: (719)535-9335