Ra 32 News

Principia Receives Unigraphics Engineering Excellence Award!

Ryan and Steve being presented the Engineering Excellence Award by Hulas King (center).

On April 29th and 30th faculty advisor Steve Shedd and team member Ryan Mcfall attended PLM World, the annual Unigraphics users conference in Orlando, Florida. Many of the major design advancements incorporated into Ra IV were made possible through the use of the Unigraphics software suite generously donated to our team by EDS (then UGS). With the aid of the program major improvements were made to the body, to the frame, and to the hubs.

The conference is an annual event hosted by the PLM (Product Lifecycle Management) division of EDS, and brings together Unigraphics users from around the world. This year approximately 1450 users were present at the conference, attending sessions in order to further explore the capabilities of the Unigraphics program and related PLM products. This software package is such a powerful CAD tool that users can not only design and validate their products in 3D virtual space, but can also design, validate, and animate whole manufacturing processes down to the smallest details for products as complex as automobiles and aircraft. Conference attendees represented both small companies and major corporations from many industries.

A large section of the conference building was dedicated to vendor displays, where vendors had booths from which they could share their PLM related wares. One of the booths was reserved for academic partners, and this was manned for a few hours by Shedd and McFall. Private training classes were offered to conference attendees, and Ryan took two – one specifically addressing the issue of how to better analyze surfaces (this will help in designing our body), and the second on how to use the software to make better curved shapes.

Our team was treated to an all expenses paid spot at the conference by EDS, and we were chosen to be one of three recipients of PLM's annual Engineering Excellence Award for academic partners. (The other two recipients were the University of Michigan, and the University of Missouri-Rolla.)

Perhaps the most valuable aspect of the conference for the Principia Team was the opportunity to develop relationships with a number of universities and individuals. For example, Shedd met a faculty member from SIUE Edwardsville (a university campus not far from Prin) whose Unigraphics equipped machine shop could mill some of the suspension pieces for Ra V. The team was especially grateful for several opportunities to thank Hulas King, Director of Global Strategic Partnerships at EDS, for his tireless support of our project.

By Matt Franking

Ra IV to Race May 15-17!

As detailed by John Broere in the last newsletter, the team will be racing our 2001 car at the 2002 FormulaSun Grand Prix in Topeka, Kansas. The whole event lasts from May 13-17, with inspection of cars taking place on the 13th and 14th, and the race from the 15th through the 17th.

Please email Principiasolarcar@hotmail.com to subscribe for daily race updates. The team will also be maintaining a race hotline at (618) 374–5656, featuring a regularly updated recording with information about the race.

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New Race Trailer Arrives

After months of planning, and after searching for an affordable manufacturer, we selected Wello Cargo, Inc. in Elkart, Indiana, to build our new trailer. The team placed our order and then waited in anticipation during the construction of the trailer.

Now our long-awaited trailer is finished, and was picked up late last month. The overall length is 36 feet, with a 28-foot box and an 8-foot "gooseneck" overhang that will attach to a hitch inside a truck bed. We are thrilled to have this specially designed trailer that will meet our specific racing, storage, and transportation needs. A partitioning wall will divide the box into two sections that will keep the solar car safe from the tools and equipment that will be stored at the front of the trailer.

The new trailer, weighing 6,000 pounds, is rated to carry 14,700 pounds. With a lightweight solar car contributing less than 500 pounds, we will be able to carry all our tools and gear for a cross-country race.

The first use of our new trailer will be our upcoming race in Topeka, Kansas. The Principia College Facilities Department is making available to us their gas-powered flatbed dump truck for this race. The flatbed dump is only strong enough to pull the trailer with a load of 1300 pounds. We thus must carry the rest of our supplies in a rented trailer to Kansas.

We are continuing our search for a suitable truck with enough towing capacity to take advantage of our new trailer. It will have to be a one-ton truck with dual rear wheels for stability. A diesel engine will provide the needed torque, fuel economy, and endurance for the job. We have found a gooseneck to fifth wheel adapter that allows us to consider acquiring a broader range of trucks.

Since the cost of buying such a vehicle new or used is prohibitively expensive, we are looking for trucks that dealers will be willing to rent to us for the duration of the race next year.

By Chad Reid and Alison Wiegand

Above: Team members Chad Reid and Alison Wiegand in front of the skeleton of the new trailer while under construction in Elkhart.

Below: Sid Williams stands in front of the facilities truck as it is being modified to pull our new trailer.

ASC 2003 Kick-Off Conference

Each Spring following the biennial solar car road race, the winning team hosts a pre-event conference for the next competition, bringing together solar car teams to share ideas on the do's and don'ts of solar car racing. The kick-off conference for the 2003 race was hosted by the University of Michigan from April fifth through the seventh in Ann Arbor, Michigan.

Principia sent eleven team members to the conference, and the team would like to thank Mrs. Dolores Lovejoy of Milford, Michigan, for welcoming us into her home and providing a place for us to sleep during the three day event.

Team members attended a variety of presentations and discussions covering various aspects of solar car design and racing. Several of the presentations were given by leading experts in the automotive industry, who added their insights to challenges faced by every solar car team – from assembling battery packs and manufacturing sleek aeroshells, to effectively coping with the intricacies of a major systems engineering project.

The balance of the presentations were given by race officials, and also by university faculty and solar car team members past and present. Joe Ritter and Steve Shedd, the Principia team's two lead faculty advisors, gave a presentation on public relations and fundraising, sharing that topic with the former project manager of the University of Michigan team.

While the conference itself was informative and valuable to all of the teams present, even more so were the interactions amongst the teams and race officials that occurred in-between and after sessions. It is during these times at such events that important relationships with other

developed and maintained. Experienced teams often share ideas and knowledge with new teams – the University of Missouri at Rolla, for example, opened up their shop to the our team after the 1999 race.

We were excited to see almost a dozen new teams at the kick-off conference, and also some (such as Purdue) that are getting back into solar car racing after a hiatus. We have offered to give the Franklin college team (one of the newcomers) a tour of our shop, and to help them however we can.

News from the Conference

A few of the highlights of the conference include the following news. We have learned that the race route for the next American Solar Challenge will again follow Route 66, and will be largely unchanged from the previous route. The two significant changes mentioned are that there will now be four overnight staged stops along the route, and that the race will go through Joplin, Missouri, instead of diverting through Neosho. In addition to the three staged stops in 2001 – Chicago, Rolla Missouri, and Barstow, California – the teams will likely also stop in Albuquerque, New Mexico.

The team was grateful to learn that the two thousand dollar entry fee for the next ASC will be waived for our team because of our first place finish in Formula Sun Grand Prix just before ASC 2001.

We also were able to again reserve "32" as our car number, and the name "Ra V" was officially accepted as the name for the 2003 car.

By Matt Franking

New Frame Finished!

Ra V Design and Construction Updates

After months of computer testing and analysis, the design for the frame of Ra V was completed last quarter. Since then, it has been welded and delivered to our shop.

Electrical leader John Broere and Faculty Advisor Steve Shedd drove to North Carolina over spring break to pick up the frame from expert welder Steve Brinkley. Having welded the frame for our third car, Ra III, Brinkley was more than willing to lend his skills to the construction of Ra V's frame.

The difference between the two frames is striking: Ra III's frame was made of two inch steel tubing and weighs upwards of 300 lbs. Ra V's frame is made of one inch aluminum tubing and weighs less than 20 lbs. Car leader Kevin Pratt was amazed that he could pick up the frame with one finger. Chris Churchill and Pratt spent spring break welding slight modifications to the frame to enhance the roll bar strength as well as planning where to mount steering components.

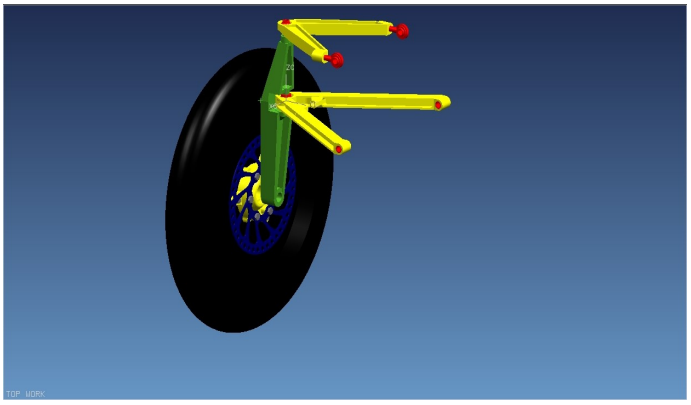
Besides being light, the new frame's chief benefit is its thickness, or more accurately, its thinness. At 9 inches from top to bottom, it is the smallest frame Principia has ever built. The roll bar extends a mere 6 inches above the frame, allowing for a small canopy and improved aerodynamics. Over the next quarter, the team plans to get the frame rolling. This will include adding suspension, steering, and braking systems.

By Chris Churchill

Suspension Design Complete

In moving from Ra IV to Ra V, the basic suspension design has changed little, while the components themselves have changed much. Two of the systems that have undergone major part changes are the brakes and shocks.

Ra IV's braking system was composed of a tandem master cylinder and retractable calipers. The master cylinder is connected to a brake pedal and drives hydraulic fluid to the calipers, which squeeze on a brake disc attached to the solar car's wheels, stopping the car. Ra IV's calipers were very large, and their extraordinary size forced the designers to widen the distance between the wheel and kingpin. This resulted in three inches of suspension parts that stuck out next to the wheel under the body, causing unneeded aerodynamic drag.



Above is a screenshot of the left forward suspension. Visible are the upper and lower A-arms, the kingpin, the brake disc, and the wheel.

For Ra V, we have decided to upgrade to hydraulic mountain bike brakes. With two calipers on each wheel, these brakes will provide more than enough stopping power and will fit entirely inside the wheel. They also weigh much less, and use a brake rotor that is less than half the thickness of Ra IV's. To retain an acceptable level of strength, our super-thin brake discs will be made of titanium.

In the realm of shocks, the team is once again sticking to mountain bike shocks, but from a different manufacturer. In

order to improve over the hard ride of Ra IV, we have commissioned Risse Racing Tech from Redding, California, to manufacture custom shocks for Ra V. Kevin Risse and his team have designed custom shocks for over a dozen solar car teams, and they do it at a discount of greater than fifty percent off of the store bought prices.

By Chris Churchill

Fine Tuning the Body Design

Testing new body designs for Ra using CFD software is a time consuming, complex process. It would be nearly impossible for our team to do this without the aide of our Fluent Software and the workstations donated by Sun Microsystems. Recently, our team has studied online lectures and seminars directed at the automotive industry regarding our CFD software – and have been adapting our computer modeling techniques to yield drag forces that would be less than 5% off from actual wind tunnel/road tests.

The primary forces we review when testing a computer model in our virtual wind tunnel are aerodynamic drag and lift. Drag is the force trying to slow the car, and is an important force to minimize – as power must be spent to overcome drag. Very generally, the slimmer, smoother, and shorter the car, the lower the drag. However, the mechanical team and driver have informed me that we can only make our car so thin – and so the team must come up with more ingenious ways to minimize drag.

The other major force retarding the motion of the car is lift. Lift, depending on the direction of the force, is either forcing the car into the air, or pushing it down into the ground. Both directions of force waste the solar car's energy, and a solar car will ideally generate zero lift. Of the two forces, lift is secondary but nevertheless important.

At the time of writing this newsletter, we have finished the selection of the basic body design, and are in the process of fine tuning it. It is a much smoother and more gently sloped shape than our last body, and is about 17 inches tall from the top of the canopy to the bottom of the belly pan. According to Fluent, the new shape has significantly lower drag than did Ra IV's body.

By Ryan McFall

Ryan McFall

Adopt –A-Trailer Donation: $15000	**Ra 32 Club** Donation: $1000	**Adopt-A-Cell** Donation: $500	**Adopt-A-Battery** Donation: $100
Rewards: • Your name or organization's name on Ra V* • Your name or organization's name on our race trailer • Subscription to *Ra News* • Receive two blue/gold race shirts (more negotiable)	Rewards: • Your name or organization's name on our race trailer • Subscription to *Ra News* • Receive a blue and gold race shirt	Rewards: • Adopts one solar cell • Subscription to *Ra News* • Receive 2 T-shirts	Rewards: • Adopts one battery cell • Subscription to *Ra News* • Receive a T-shirt

Please address contributions to:
Fundraising Chairman
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E-mail: solar@prin.edu Web-site: www.prin.edu/solar
Please make checks payable to: Principia Solar Car Project

All contributions are gratefully accepted and tax-deductible to our 501(c)(3) educational organization.
Please include a corporate matching form if your employer participates in such a program.
*Space on Ra V will be extremely limited and is not guaranteed

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