# Auburn University – Romance, Rocketry, and the Dannenberg Connection

## Dr. Joseph Majdalani, faculty advisor at Auburn University

Auburn University is not only known for its campus beauty, college romance, and passion for football, but also for its celebrated history in aeronautics, its love for rocketry, its faithful devotion to the AIAA community, and its intimate connection with the Wright Brothers and the Dannenberg family.

This year was particularly romantic as it seems to have started and ended with two totally unrelated events, which nonetheless involved Auburn's incoming Chair for Aerospace Engineering, Dr. Joe Majdalani, and two distinguished members of Konrad Dannenberg's immediate family, whose association with Auburn University dates back to the Apollo era: Dr. Klaus Dannenberg, '67 Auburn Aerospace Engineering and AIAA Deputy Executive Director, for the SciTech Award Banquet, and Jacquelyn (Jackie) Dannenberg, wife of Konrad Dannenberg, for the awarding of the Konrad Dannenberg Educator of the Year Award in Huntsville.


**LTR: Konrad and Klaus Dannenberg at the Auburn Alumni Engineering Council Meeting (April 2007).**

The year also encompassed a number of developments and recognitions, such as a record participation in the AIAA Region II Student Conference with 20 Auburn students, a first place award capture in both undergraduate and graduate divisions of the 65th AIAA Southeastern Regional Conference, a first place award ranking among all seven regions of AIAA at SciTech'14, a successful involvement in both Design/Build/Fly (DBF) UAV and USLI rocket competitions, the launching of several new websites for the AIAA Auburn branch, DBF, and the Auburn University Rocketry Association (AURA), several outreach activities involving middle

schools, high schools, E-day, TALONS day, Summer Camp, the Alabama Power Enrichment Program, and a number of new initiatives that are hoped to strengthen Auburn's involvement in the AIAA society.

Our activities started in fall 2013, with Dr. Majdalani's series of technical seminars to the AIAA community, and his commitment to increase enrollment and support AIAA activities. It also foresaw the distribution of a comprehensive set of research topics to both graduate and undergraduate students, with the goal of increasing participation in research and student papers for the upcoming April competition. With the additional support of Professors Ahmed, Hartfield, Sinclair, and Thurow, a record number of students were selected to compete in the 65th AIAA Southeastern Regional Conference. The outcome was fabulous.

The Dannenberg Connection, Dr. Klaus Dannenberg (SciTech'14, Jan 13-17, 2014)
However, the first Dannenberg encounter took place at SciTech'14, with a meeting between Dr. Klaus Dannenberg and Dr. Joe Majdalani, who succeeded Dr. John E. Cochran, Jr. as Chair of Aerospace Engineering at Auburn University. Klaus and John had decided to retire back-to-back, as both had been back-to-back Auburn co-eds and classmates. At the meeting, Dr. Majdalani learned that this event would mark Dr. Dannenberg's last appearance as AIAA's Deputy Executive Director.


**LTR: Drs. Joe Majdalani and Klaus Dannenberg. Photo by Bill Petros.**

Dr. Dannenberg was a classmate just behind Dr. Cochran at Auburn, graduating with a Aerospace Engineering B.S. in 1967 and an M.S. in 1968 (in Controls) followed by a Ph.D. in Information and Controls from SMU in 1972. As a GN&C engineer from Huntsville, he initially worked on the Apollo and Skylab, then the Hellfire and Patriot rockets. He then moved to Lockheed in Texas as Chief Engineer for an early Unmanned Air Vehicle (the Army Aquila program) and performed ground station research for DARPA's forerunner of the Global Hawk. In the late 80's, based on mission planning work for unmanned systems, Dr. Dannenberg shifted

his attention to visualization graphics, modeling and simulation, thus landing at CACI where he ran their M&S business for 10 years, including constructive and virtual instrumentation for live simulations.

In 2005, after serving on the AIAA Board of Directors for several terms in various positions, Dr. Dannenberg joined the AIAA staff as Deputy Executive Director. In that position, he assisted on a variety of issues and would welcome the opportunity to do so again. In 2014, he decided to retire and move to Texas.

First Place in the Masters Division, All Regions AIAA (SciTech'14, Jan 13-17, 2014)
At SciTech'14, formerly known as the 52nd Aerospace Sciences Meeting, Dr. Majdalani and Andrew Fist, graduate research associate, took first place for their research paper in the international competition of the masters division held in National Harbor, MD. The paper, "Improved Mean Flow Solution for Solid Rocket Motors," which was presented by Fist and authored by Majdalani introduced a groundbreaking framework for modeling the steady-state motion associated with internal burning cylindrical rocket motors. It was written based on research that Majdalani performed under a National Science Foundation grant.


**LTR: Andrew Fist and Majdalani, winners of the Masters Division in all 7 regions.**

Majdalani and his team have now competed and claimed top honors in the past five years, with eight papers which have won at regional events as well as three international AIAA conferences. "For seven papers to have won nine awards in four consecutive years at this level of competition is truly a remarkable and tremendous achievement," said Christopher B. Roberts, dean of the Samuel Ginn College of Engineering. "This is a testament to the hard work, dedication and high quality research from Dr. Majdalani and his assistants, and clearly their efforts are paying off. I am proud his team is placing the department, and Auburn University, in the spotlight for the industry to take notice and recognize," he said.

The competition, held in January, in National Harbor, MD, featured finalists from all regions of AIAA including the Northeast, Southeast, Central, South Central, Midwest, Western, and international regions. To qualify, Fist and Majdalani had to first compete and earn first place in the masters division of the 64th AIAA southeastern regional student conference. With a total of 170 delegates from 16 universities across the Southeast, participation was at a record all-time high in Region II, which also happens to be the largest within AIAA. In addition to this award, Majdalani has also received the Zarem Educator Award, Zarem Paper Award (coauthor), and Special Award in scientific and academic productivity, all selected by AIAA. For more on this, see: http://www.eng.auburn.edu/news/aiaa-research-paper-award.html

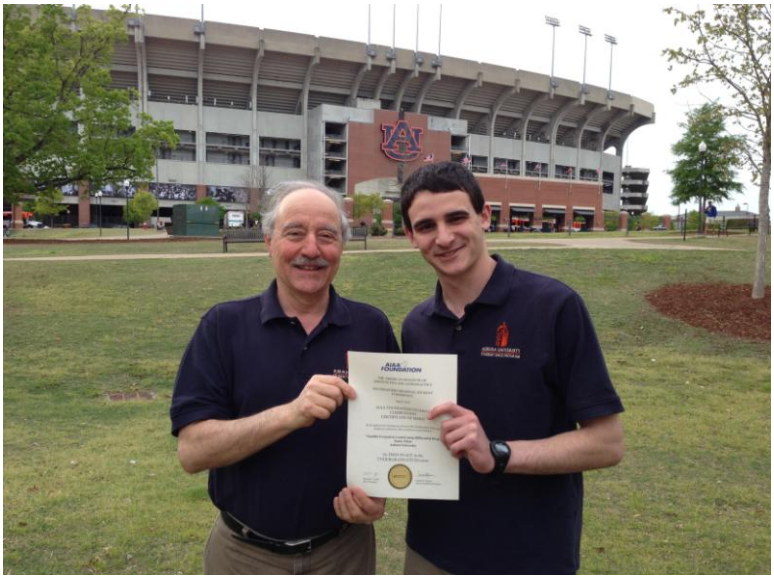
**LTR: AEDC Commander Toth, Majdalani (recipient of the 2013 AIAA Special Award) and Dr. Roy Schulz.**


**Former AIAA President Paul D. Nielson and Majdalani. Photo taken by Mark A. Nelson on January 8, 2013, Grapevine, Texas.**

To maintain this unbroken record, Dr. Majdalani has since competed with one more paper in the Masters Division with Josef Fleischmann on April 7-8, 2014. The pair took 1st place for the fifth year in a row, thus bringing this team's record to eight-out-eight best regional awards.

First Place in Undergraduate and Graduate Divisions (Region II Conference, April 7-8, 2014)
Josef Fleischmann and Joseph Majdalani, along with Sanny R. Omar and Jean-Marie Wersinger, of the Aerospace Engineering Department of Auburn University, competed this year in the Masters and Undergraduate Divisions of the 65th AIAA Southeastern Regional Conference and won first place awards in both graduate (Fleischmann) and undergraduate divisions (Omar). Their papers entitled, "Complex Lamellar Helical Solution for Cyclonically Driven Hybrid Rocket Engines," by Fleischmann and Majdalani, and "Satellite Formation Control Using Differential Drag," by Omar and Wersinger, mark, on the one hand, an unprecedented five-year winning streak for Dr. Majdalani's graduate students, and, on the other hand, a dominant performance for Auburn University in the undergraduate student competition. More detail on this can be found here: http://www.eng.auburn.edu/news/2014/04/aerospace-aiaa-conference.html

**LTR: Majdalani and Josef Fleischmann, 1st place winners of the graduate student competition.**



**LTR: Dr. Jean-Marie Wersinger and Sanny Omar share the AIAA honor.**

Thanks to Omar and Wersinger, the Stan Powell plaque returned, for the third time, to Auburn University, where it will remain displayed for another year on the AIAA bulletin board. At the graduate level, this event also bolsters Dr. Majdalani's team record for the fifth consecutive year.

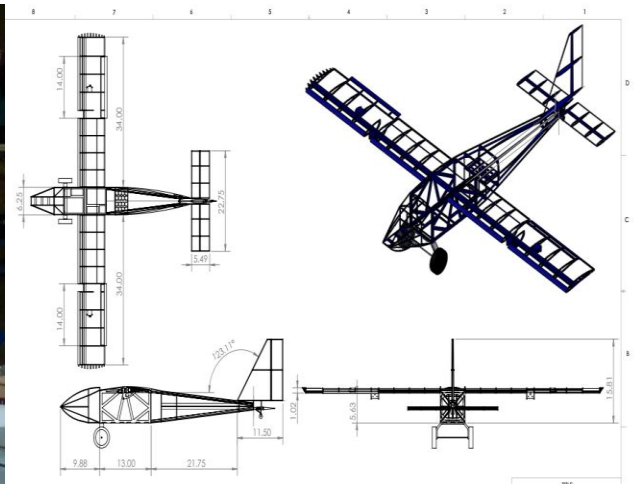
Thus far, his team has competed with a total of eight papers in the Masters Division and placed first in 2011 - 2014, second in 2010, 2012, 2013, and third in 2010. The eight-out-of-eight award record is clearly the result of hard work and good planning on behalf of Dr. Majdalani and his students. It also speaks volumes regarding the originality of scientific topics chosen by these researchers.

The 65th Annual Southeastern Regional Student Conference was held in Memphis, TN, April 7 and 8, where it was hosted by University of Memphis and the Student Branch of AIAA in Memphis, TN. A total of 150 student delegates from 14 southeastern universities competed this year. Participating universities included: Alabama A&M University, Auburn, Florida Tech, Georgia Tech, Mississippi State, North Carolina State, Southern Polytechnic State, Tuskegee, Alabama (Huntsville and Tuscaloosa), Florida, Memphis, South Carolina, and Vanderbilt.

<u>Design/Build/Fly Competition (Wichita, Kansas, April 11-13, 2014)</u>
In addition to these awards in the undergraduate and graduate divisions, it should be remarked that Auburn's Design, Build, Fly (DBF) team took third place in the AIAA team competition. The corresponding paper, "Design, Fabrication, and Testing of a Medical Transport Remotely Piloted Vehicle," was coauthored by Aurie Adams, Christopher Elliott, Jonathan Ezell, Matthew Oakes, and Andrew Twesme. Their work was supervised by Dr. Norman Speakman and Nicholas Householder, who were named the 2014 Most Outstanding Faculty Member and Graduate Student by Auburn's AIAA Student Chapter.

**Auburn University's Design/Build/Fly Team.**

The same DBF team competed this year in the 2014 AIAA Student Design/Build/Fly Competition in Wichita, Kansas, on April 11-13, 2014. Although the team did not win, they were commended by the event pilot for having the most stable and maneuverable plane of all those he flew. The Auburn aircraft performed exceedingly well despite the strong gust and high wind conditions on the day of the competition.



**LTR: Dr. Norm Speakman and Nick Householder, working on the AIAA DBF "bush" plane.**

<u>Auburn University Rocketry Association (Salt Flats, Utah, May 14-18, 2014)</u>

In conjunction with AIAA activities, Auburn's rocketry team (AURA) completed the building of 35 High powered Level One rockets. This effort consisted of building a rocket 4 feet in length and 3 inches in diameter. This resulted in 10 members achieving a Level One certification to fly high powered rockets, with the rest of the members launching in the fall to complete their certification process. In addition, AURA competed in the NASA University Student Launch Initiative with project Nova.

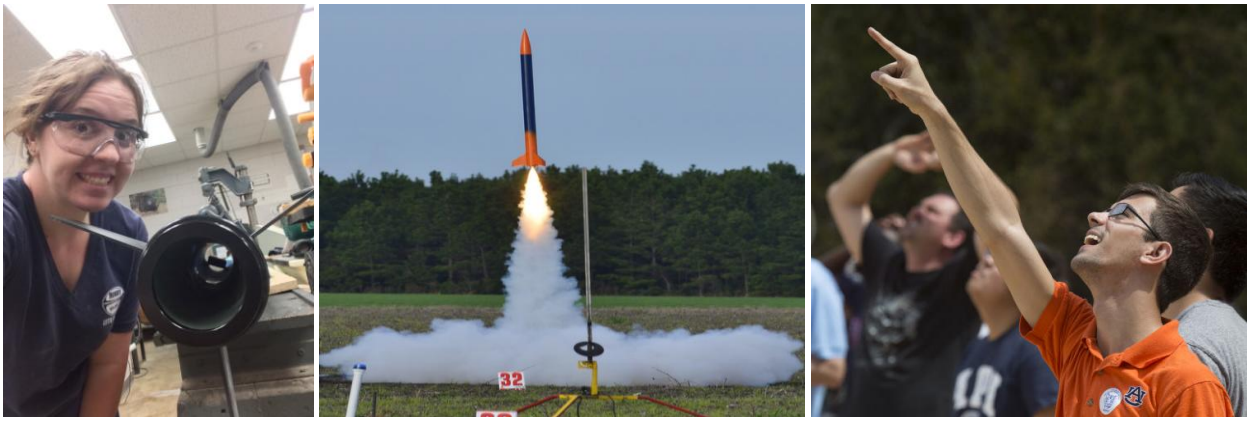

**AIAA/NASA sponsored Project Nova: Auburn's NASA/AURA participation in the University Student Launch Initiative in Salt Lake City, Utah, May 14-18, 2014.**

In order to fulfill the program requirements outlined by NASA, this year's team has built a rocket that is designed to reach approximately 17,500 feet AGL while achieving a maximum Mach number of 1.2. The corresponding Nova rocket consisted of a 9-foot tall rocket with a 5-inch diameter, which used a class N motor, with an average thrust of 2200 lbs. The team has successfully launched both a subscale model, comprising a 6-foot long/4-inch diameter rocket, and a full-scale shakedown flight, which flew to 6100 feet using an L-motor. As the semester came to a close, the team finished preparations and competed in the USLI program by participating in the rocket launches that took place on May 14-18 at the Bonneville Salt Flats in Utah.

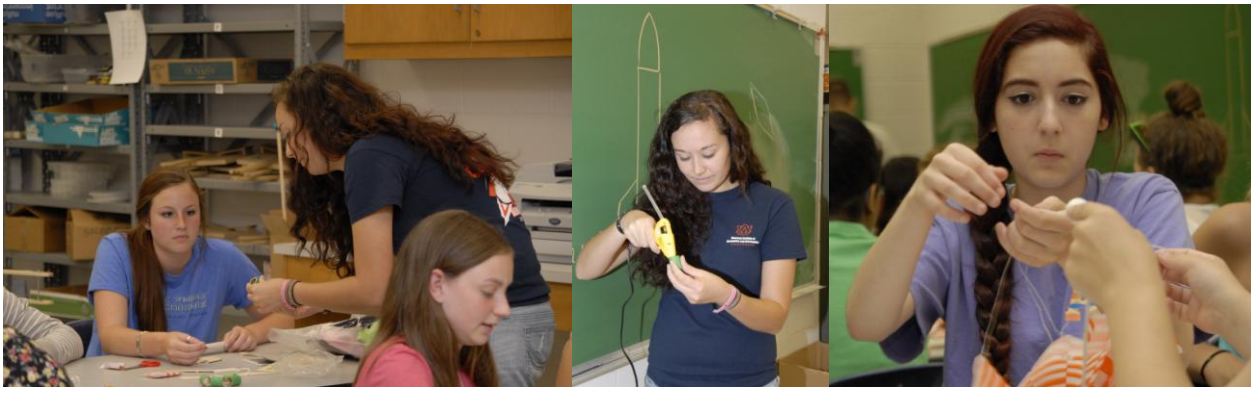
**AIAA/NASA sponsored Project Nova: Auburn's team is selected among 16 finalists for the actual rocket launch on the Salt Flats, Utah, on Saturday May 18, 2014.**

In addition, the team is preparing to start a Level 2 high powered rocketry program, for those who would have completed the Level 1 certification this year. The team has recently been recognized in the news for a three-day rocket launch at Drake Middle School in Auburn under NASA's University Student Launch Initiative program, where the team taught approximately 750 students about what astronauts go through as well as building of rockets. Featured articles were with WRBL, WLTZ, and WTVM.

**Outreach activities sponsored by Auburn's AURA team, which included science instruction at the Drake middle school.**



**Outreach activities sponsored by Auburn's AURA team, which included science instruction and rocket demonstrations to 750 middle school students.**



**Outreach activities sponsored by Auburn's AIAA team: group photo with Dr. Majdalani and individual photos depicting Luke Humphreys (AIAA Branch Secretary) and Bethany Bittinger (Historian) providing classroom instruction and rocket demonstrations to an all-girls class of students (June 13, 2014).**


**Outreach activities sponsored by Auburn's AIAA team: individual photos depicting Luke Humphreys (AIAA Branch Secretary) and Bethany Bittinger (Historian) providing classroom instruction and rocket demonstrations to an all-girls class of students (June 13, 2014).**

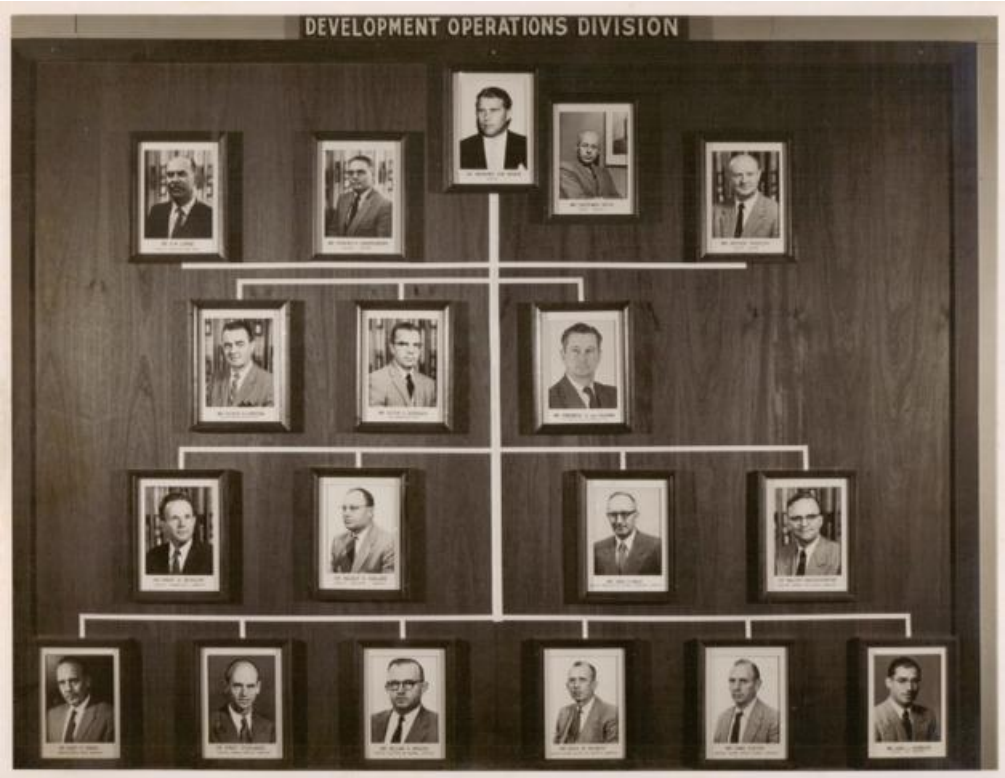
The Dannenberg Connection, Jackie Dannenberg (Greater Huntsville, June 6, 2014)
In closing this year's activities, Dr. Majdalani was recognized as a distinguished STEM educator in June. He was honored with the Konrad Dannenberg Educator of the Year award, which is presented by the Greater Huntsville Section of AIAA. This award is given to a section member who has exemplified "outstanding service to education and promotion of math and science within the community." It is named after Konrad Dannenberg, a German-American rocket pioneer who was an avid proponent of education, an active AIAA member, and an inspiration to the aerospace community. Chris Crumbly, '88 aerospace engineering alum, and manager of the Advanced Development Office for the Marshall Space Flight Center Space Launch System (SLS) program, nominated Majdalani. Recipients were recommended by an awards committee and sent to the board of directors for its approval. Majdalani was selected among six finalists.

Majdalani was presented with the award by Jacquelyn Dannenberg at the 62nd Annual Awards Dinner of the AIAA Greater Huntsville Section on June 6, 2014. The attendance list consisted of a large numbers of illustrious names in the community, including Drs. Mike Griffin and Richard Hallion, two of Majdalani's idols. More detail on this can be found here: http://www.eng.auburn.edu/news/2014/06/majdalani-educator-of-year-award.html


**LTR: Ram Ramachandar, Jacquelyn Dannenberg, Majdalani and Richard Hallion. Photo by Arloe Mayne.**

Dannenberg is widely viewed as Werner Von Braun's right-hand as both played a key role in establishing and furthering our rocketry program. Majdalani has been instrumental in student

success at national AIAA competitions. He has served as a mentor to students who have won eight regional AIAA Best Paper awards and two national awards; moreover, he has been a strong advocate for science, technology, engineering and math (STEM) within middle and high school-level students by leading rocket and science camps. Overall, he has fulfilled several STEM outreach activities sponsored by NASA, AIAA, and the National Science Foundation (NSF) by promoting, for example, participation in the BalloonSat program, the University Student Launch Initiative (USLI), the Design/Build/Fly (DBF) experience, and the AIAA student paper competition.




**Organizational chart for Werner von Braun Rocketry Development Operations Divisions. Note that Konrad Dannenberg and Eberhard Rees, von Braun's Deputy from Peenemunde, appear to the right and left of von Braun, respectively. Photo provided by Jackie Dannenberg.**

Recently, Majdalani used NSF funding to provide support for two Research Experiences for Teachers (RETs), which involved Brett Williams and Rebekah Hyatt, two outstanding high school teachers, AIAA associate members, and devout members of the highly effective SystemsGo aeroscience curriculum. Finally, Majdalani has fostered the development of two AIAA short courses that are taught internationally in the areas of applied mathematics and hybrid rocket propulsion. The Hybrid Rocket Propulsion short course, which is taught with Dr. Arif Karabeyoglu from the Space Propulsion Group, is scheduled to be offered again at the conclusion of the Propulsion and Energy meeting in Cleveland, OH.

"I am thrilled and humbled to receive this award," said Majdalani. "To be recognized by such a distinct AIAA group is a tremendous honor. The greatest reward for me is working with students who dedicate themselves to empowering the aerospace industry."

Klaus and Jackie Dannenberg are presently working with Majdalani to establish a permanent website and a repository for Konrad Dannenberg's material that has survived to date. The material consists of manuscripts, reports, and rare photographs taken with various dignitaries and scientists, such as Max Valier, before and after WWII. They are also planning on establishing scholarships and fellowships that pay tribute to and commemorate Dannenberg's legacy, specifically, as one of the leading rocket scientists to have ever lived.