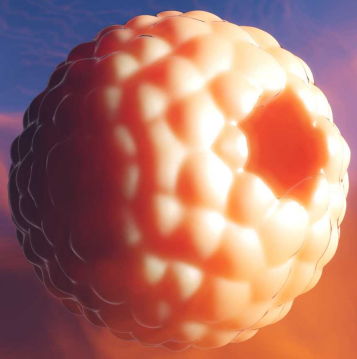
FEBRUARY 2020

3D Technologies @SAC
FACET Monthly



FACET Monthly is dedicated to spreading the word about 3D technologies in the Lone Star State.

ALAMO COLLEGES DISTRICT
San Antonio College

FACET Monthly
3D Technologies @ SAC

Volume 1, No. 2

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Funding:
FACET is funded through a U.S. Department of Education Title III HSI grant. (#P031C110039)

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EDITORIAL:
TOUCHING STORY

by **Aaron Ellis**

Let's face it. We live in the future. Maybe it's not the future we hoped for and perhaps it didn't arrive when we expected, but the world that is now is full of wonders all the same. We regularly interact with things previous generations could only dream of. Video phone calls, online shopping, and even virtual reality are all commonplace. Technology is used every day in innovative ways to enrich the lives of billions of people all across the Earth.

Not long ago, thanks to modern scanning, sculpting, and printing tools, four visually-impaired mothers-to-be from Brazil were surprised to meet their children a bit earlier than they expected. Ultrasound imaging has been around for a while and families often catch first glimpses of their unborn children on monitor screens. But how would that work for someone who is blind? "Meeting Murilo" is a short film that shows how doctors and technicians helped one of these mothers, Tatiana Guerra, "see" her child for the very first time.

3D scanning a fetus in utero seems impossible, but today's ultrasound equipment can capture hidden details by bouncing sonic waves off of sub-surface shapes, measuring the return signals, and combining all of that data (using spatial algorithms) into a solid model. The process is similar to how we scan artifacts at San Antonio College, except this method uses sound instead of light.

In the filmed account of her story, Ms. Guerra is presented with a unique 3D-printed sculpture created from the ultrasound of her child. One moment she is seen asking the doctor to describe the image on the screen and the next, she is seen touching a replica of her son; his ears, his nose, and his tiny hands.

When I was growing up, bronzing baby shoes was a thing. It commemorated an important event and was fairly popular. Today we take many photographs and videos of our loved ones in both the big and the small moments of life. These spur-of-the-moment digital memories help strengthen personal connections even for those separated by space and time.

In our outreach events in the community, the FACET team offers free portrait scanning to the families we meet. Moms and dads and grandparents love getting digital 3D versions of their little-ones' faces on a thumb drive at the end of the process. I enjoy when whole families get involved. It's rare, but sometimes the children, their parents, and grandparents all get scanned together. When they do, they frequently remark on family resemblances, and even to family members who have already passed.

So far, none of the families we've scanned over the years have contacted us about the experience – so we don't know what they've done with their scans. However, I can't help but wonder how many of them had their scans printed, either at home or elsewhere. Nowadays, 3D printing services can fabricate digital scans in plastic – or platinum – for a price. Bronzed baby shoes step aside.

All of this is possible thanks to an astounding convergence of art and science and medicine and engineering. It really is a magical time to be alive. ▲

To learn more about Titania Guerra's story, visit: https://www.behance.net/gallery/65764923/Meeting-Murilo

PROJECTS:
MORTUARY PROCESSION

by **Aaron Ellis**

Humans have been on the Earth for quite a while and from all available evidence, they've been dying since the very beginning. Those left behind have long sought to memorialize their loved-ones or take a reassuring last look before interment. But sometimes that's not so easy.

In the Fall of 2013, Felix Gonzales, a Mortuary Science instructor at San Antonio College, got the idea of using 3D technologies to update MRTS 2447 – Technical Procedures II. In this class, his students learn how to use clay and wax to construct replacement facial features for decedents who sustain trauma by accident or malice. According to Gonzales, the funeral profession has been using these same materials for hundreds of years. He felt that the industry was due for an update.

Sculpting realistic ears from clay is hard for many students. But after learning that the SAC Title III office was using high-resolution scanning and printing technology to advance paleontological research, Mr. Gonzales contacted our department to see if those tools could be used to digitally copy and paste perfect facial features – or to virtually repair damaged ones and then print realistic prosthetics.

For the last twelve semesters, the FACET team has been fortunate enough to meet with around 15 of Mr. Gonzales' Mortuary Science students each term, talking to them about the possibilities of the technology and then teaching them how to use it themselves.

At first, we scanned student noses and printed student ears using our in-house Artec Eva scanner and a Stratasys Eden printer. But using our equipment for these classes wasn't ideal. Before long, the Mortuary Science department had its own medium-resolution scanner and a consumer-grade printer. That department has since upgraded to a high-resolution scanner and printer.

As a result of all of this, San Antonio College is the first and still the only educational institution in the U.S. that teaches its Mortuary Science students how to use advanced technology to create realistic facial prosthetics. Our students are graduating from SAC and entering the industry with working knowledge of these transformational tools.

In addition, every Spring semester, San Antonio College's Mortuary Science department hosts continuing education workshops for funeral directors and morticians from around the country. At each event, participants discover what our students are learning at SAC so they can carry Mr. Gonzales' idea back to their respective locales. ▲

Note: a video example is available on YouTube at https://youtu.be/Z8QnPoWPe-g


Students processing scan

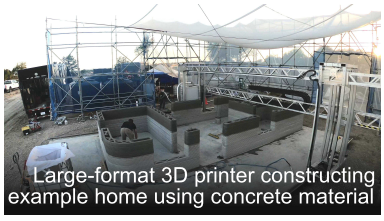

Examining a printed part


Scanned & printed student heads

NEWS:
AUSTIN COMPANY USES 3D PRINTING TO BUILD AFFORDABLE & SUSTAINABLE HOMES

by **FACET Staff**


800-square foot 3D-printed model home in Austin, Texas


Large-format 3D printer constructing example home using concrete material


Dmitri Julius, ICON Director of Operations, supervising construction

Housing costs in the U.S. are a constant concern for millions of Americans. Rent and mortgage payments rank among the highest monthly expenses for many of us. But not only is the cost of living under a roof sky-high, traditional home construction is also a trashy endeavor.

According to the Environmental Protection Agency, new housing construction generates nearly 40% of industrial waste in U.S. landfills each year. That's a lot of junk going into trailer-sized trash bins and local landfills. Maybe we can do better. And maybe technology can help.

That's what an Austin, Texas startup is attempting to do. ICON, LLC is applying high tech 3D printing processes to work in home manufacturing. Imagine an oversized glue gun mounted on a two-story frame – extruding concrete in inch-thick ribbons of curving lines. This precision process generates less waste than traditional construction while producing hurricane and tornado-resistant homes.

ICON's large-format printer, called the Vulcan II, is capable of printing an 800-square foot home at a cost of under $20,000. As the technology improves, the cost per unit is destined to drop. This is important because ICON's technology was also designed to help some of the millions of chronically homeless people around the world.

ICON is now partnering with not-for-profit organizations in Honduras, El Salvador and Mexico to help meet their housing needs quickly, cleanly, and cost-effectively.

In December of 2019, the first two homes were 3D-printed in Tabasco, Mexico. This unique development will soon contain 50 such structures and is targeted toward some of the poorest families in that nation – many of whom have been living in makeshift housing and earn less than $80 per year.

Even here in Texas, homeless souls surround us every day. If 3D printing can help provide shelter for some of the most vulnerable populations in Latin America, perhaps it won't be long before those tools or other innovations start making an impact in our local communities as well. ▲

IDEAS:
OPEN SOURCES

by **Aaron Ellis**

When we talk about technical innovations, we often imagine proprietary software and high-priced equipment. That notion is true but only most of the time. One of the greatest things about technology is that it eventually trickles down to benefit nearly everyone. Yes, there are still corporate gatekeepers diligently re-branding their products as services and charging hundreds of dollars per year for the distressingly revocable permission for us to use their tools, their way. But functional and free alternatives keep popping up all the time and all over the world. Some of them have even been around long enough to mature into viable competition to the 800-lb industry-standards in the room.

Blender is just one of those high-tech, open-source options. It's a 3D program that does just about everything; modeling, sculpting, terraining, painting, programming, animation, video editing, and more. In fact, I'm typing this article in Blender right now. Roughly half of all the images and words in this newsletter were crafted using free software that fits on a tiny USB drive and runs just fine on a cheap, pre-owned computer – and even better on a monster machine.

How can such a thing be possible? It's possible because a handful of creatives from different dots on the globe worked for 20 years to continuously remake a powerful tool and freely release it, at no charge and for zero dollars, to all. Blender is the software my students use most often in our 3D classes at SAC and they learn to love it – eventually.

Someone, somewhere, somewhen might say that Blender is difficult to learn. That's true, but not because it's free software. Nearly all 3D tools are hard to learn – even the expensive ones – and especially the powerful ones. But with Blender, the end-user is the only real gatekeeper to successful creation. If we choose to invest our time and pour our interest into it, we simply cannot avoid the rewards. ▲

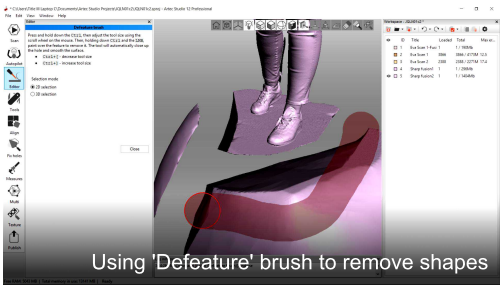
3DIVERSIONS:
MINIATURE MADNESS, part 2

by **America Wilson**

In the previous issue of FACET, I wrote about starting a fun project to build a tabletop gaming piece using 3D scan data of Jackie, an architecture student and gamer at San Antonio College. In that article I talked about the initial process of scanning her and this month I will discuss repairing and modifying the object.

The software used to process data captured by the Artec Eva scanner is cleverly called Artec Studio. This program uses photogrammetry algorithms to quickly make comparisons between multiple images and then it joins that data together to create a complete, but low-resolution model of the subject. During the session with Jackie, the scanner took 45 snapshots per second for 14 minutes, amounting to about 38,000 images. That's a lot of data! Recalculating it all for the final high-resolution model took Artec Studio nearly 45 minutes.

Once everything processed, I began repairing the scan data. The first thing I noticed was several weird shapes floating around the model. Artec Studio tries to fill-in surface gaps by "making stuff up" in the absence of usable data. This can occur due to bad lighting or objects getting in the way. Something as simple as dark shadows under the subject's arms or stray hair strands from a messy bun can confuse the software, so it has to guess what was in those areas.

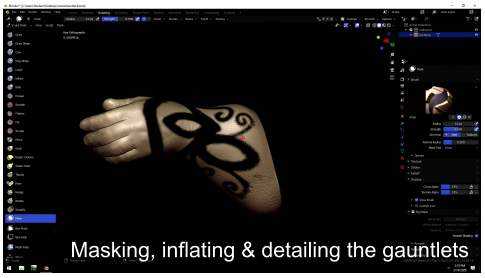

Using 'Defeature' brush to remove shapes

Removing obviously unwanted data from the scan – like the floor, the blobs around the hair, and extra fingers – can be challenging, time consuming, and very frustrating. I spent several hours in Artec Studio using the defeature and smoothing tools to fix these issues. Eventually I realized that the software, although powerful, took a long time to make changes to large models. To save time, I switched the Jackie scan to Blender 3D (see article above to learn more about this software).

Artec studio made defeaturing difficult in tight spaces of the model because the tools would sometimes affect parts I didn't intend to modify. Blender however has a nifty masking tool to protect parts of the model that aren't being edited. And it has a dynamic defeaturing option that can quickly erase unwanted elements. After moving to Blender, the repair and editing work went much faster.

Before starting on custom modifications, I asked Jackie what her miniature should wear and how it would be equipped for the game she plays. The concept she adapted for this model is of an enchanted character that is heavy armored, wears a jet-pack and has mechanical wings. I knew that the tools in Blender would make it easy to fabricate new objects to merge onto the original model. I also planned to make the clothing and hair modifications using sculpting tools – something like digital clay that can be molded, smoothed, pinched, and nudged.

Early printing tests for the Jackie model revealed a problem, however. Because the finished figurine would only be 36mm tall, some parts were very thin and the hands kept breaking off at the wrists during print clean-up. This prompted the idea of thickening the wrists by adding gauntlets to the model. This solution fit well with Jackie's character concept. The mask and inflate sculpting brushes facilitated the creation of the gauntlets. But, since the full scan model sometimes blocked my view, I had to use the box-hide feature in Blender to temporarily remove body parts that got in the way. This tool allowed me to move around the arms more freely while I used the masking brush again to add decorative detailing to the gauntlets.


Masking, inflating & detailing the gauntlets

Sculpting and modeling these modifications added only five hours to the final project, but the extra time was so worth it to end up with a really cool gaming piece – which will be revealed next month. Also, in the final article in this series, we will be looking at print preparation, printing and then cleaning the fragile parts of the finished model. ▲

Note: video example available at https://youtu.be/7Ji2Rz534_c

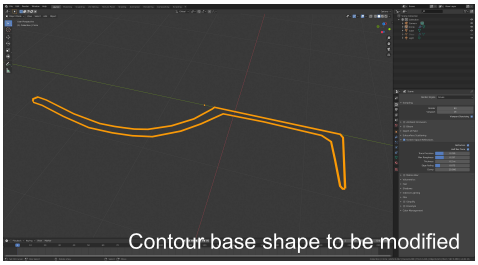
TECHNIQUES:
PROFILES IN LIQUID COURAGE

by **FACET Staff**

Last month's Techniques article demonstrated that 3D development doesn't always have to be a painful process. Sometimes it can even be fun. We learned in the last issue that Modifiers are handy tools to help make difficult tasks easier. We used Boolean operations to subtract pre-existing objects from other objects to make entirely new shapes.

Sticking with the same general concept of tweaking simple models into something greater, this time around we will use the Screw modifier in Blender 2.81a to create objects with radial symmetry. "What's that?" you may ask. Radial symmetry is seen whenever a shape or edge revolves around a central axis. Examples of such forms include bottles, bells, and turbine engines. But let's not forget to mention spindles, lamps, and toilet plungers. Those are important too. Spinning complex objects from simple contours is a useful modeling skill and it's super-easy to learn.

The Screw modifier is intended to repeat one "prototype" shape completely around a specified axis and then automatically join all of the edges to create an entirely new object. Although the Blender spinning process is effectively a reversal of more traditional, subtractive methods, the results of the Screw action look similar to work produced by a lathe or some specialized routers.


Contour base shape to be modified

The most important aspect of a successful Screw modifier operation revolves around the creation of the initial profile. This is the cross-sectional view of what could be seen as half of one thin slice of the finished radial object.

This base shape should have a few traits in order to work properly. First, the profile should be a closed loop – meaning that it should have no unconnected links at all. Second, it should be unfilled – just edges and vertices with no faces. Third, its origin point should be positioned somewhere along the rotational axis of the intended model. All of these aspects work together with the Screw modifier to create smooth, "solid" objects with perfect radial symmetry.

With all of that in mind, we can start off this project using a Circle object as the only primitive needed. Other primitives could be used, but the circle is easiest as it already meets the criteria mentioned above. The only thing left to do before beginning is deciding what to make. For this example, let's plan to craft a wine glass or maybe a champagne flute.

In a brand-new Blender scene, after deleting the starting cube object, let's add a circle primitive by clicking the Add menu option, followed by the Mesh sub-option, and then the Circle sub-option. The new circle that is added to the scene should have 32 vertices, a radius of 1m, and should be unfilled by default. That's perfect for our needs.

To turn the circular shape into a more useful cross-section, we will need to select the new circle (if it's not already) and switch to Edit mode for that object. Just tap the Tab key on the keyboard one time to enter Edit mode. While in edit mode, the most important task is to select each of the vertices (dots) along the outside of the shape and Grab/move them in the X and Y axes only – one after the other – until they form the desired shape. This can be a time-consuming and tedious process. Be sure not to move the vertices in the Z axis or your final object will have weird protrusions and odd intersecting geometries.

Now that you have moved all 32 vertices in the X-axis and moved them all again in the Y-axis until they form a joined profile of your desired shape, you should finally be ready to apply the Screw modifier to your object. Make sure you exit Edit mode (tap the Tab key on your keyboard) first though. With your profile object selected, locate and click the Modifiers tab icon in the Blender 2.81 right-side panel. The icon should look like a blue wrench. Once in the Modifiers panel, click on the Add Modifier button, and then locate and click the Screw option near the bottom of the second column of choices. The Screw modifier should now be available to edit. Next, you will need to change the Axis option to Y, then make sure that the Angle and Steps options are set to 360 and 16 respectively (they should be by default). That's it. Super-easy.


Wine glass completed with Screw modifier

If you did everything right, you should now have a perfectly-formed virtual wine glass or flute. Go ahead and celebrate. You've earned it. ▲

Note: a video example can be found at https: //youtu.be/-x8GiKo6GJc

CLASSES:

San Antonio College offers 3D Technology classes every month. Most of our classes meet once a week for three hours on Fridays. Most classes meet for a total of two, three or four weeks, depending on the discipline. Class costs are low and priced for the entire class (not per session). Our 3-4 week 3D Visualization class is always free of charge. Off-schedule classes can be arranged for groups of five to ten students and include all of our offerings. Contact us about registration details or for more information by e-mail at aellis43@alamo.edu or call (210) 486-1223. ▲

COURSE TITLE	DAY	TIME	LOCATION	START DATE	END DATE	PRICE
3D Sculpting and Design	Friday	9:30 AM – 12:30 PM	SAC/MLC 651	01/10/20	01/31/20	$35.00
3D Printing and Fabrication	Friday	9:30 AM – 12:30 PM	SAC/MLC 651	02/07/20	02/21/20	$35.00
3D Visualization	Friday	9:30 AM – 12:30 PM	SAC/MLC 651	03/06/20	03/27/20	FREE
3D Modeling	Friday	9:30 AM – 12:30 PM	SAC/MLC 651	04/03/20	04/24/20	$35.00
3D Sculpting and Design	Friday	9:30 AM – 12:30 PM	SAC/MLC 651	05/01/20	05/29/20	$35.00