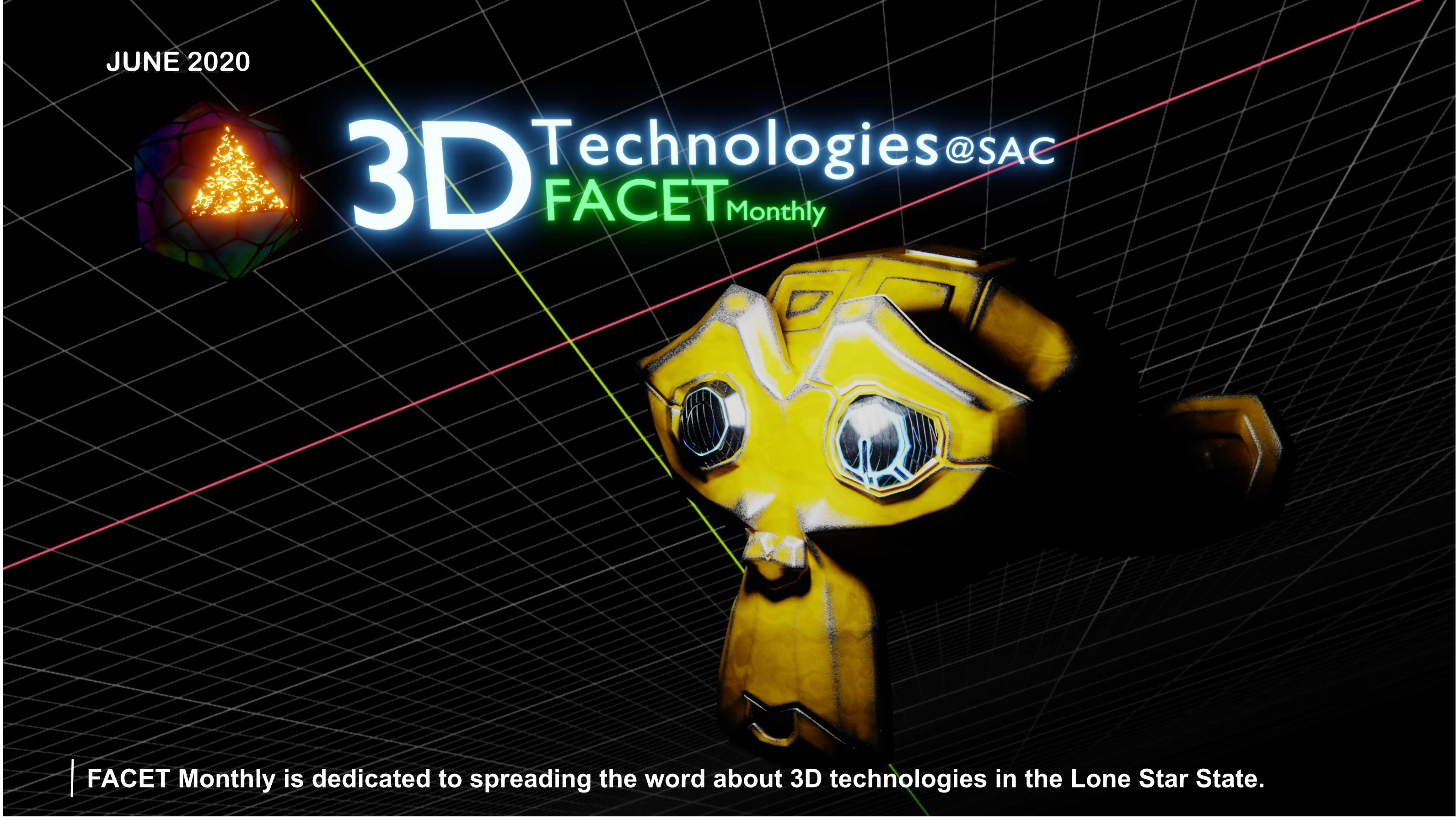


ALAMO COLLEGES DISTRICT
San Antonio College

FACET Monthly
3D Technologies @ SAC

Volume 1, No. 6

Director:
Dr. Barbara J. Knotts

Editor:
Aaron Ellis

Contributors:
Jackie Black
America Wilson

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

Contact:
To connect with FACET staff regarding articles, news, events or projects, contact:

Aaron Ellis
Academic Program Coordinator
(210) 486-1223
aellis43@alamo.edu
MLC #648

EDITORIAL: ADAPTIFICATION

by **Aaron Ellis**

One of the great and terrible aspects of the software that is at the center of our 3D technology classes at San Antonio College is that it is constantly changing. In 2006, when I first discovered Blender, I was already deeply embedded in another modeling program and wasn't persuaded to make the switch.

At the time, the interface was clunky and the design philosophy was altogether foreign to me. That's understandable since the software was originally written by a Dutch programmer and has since been maintained by a growing stable of volunteer coders from all over the world.

Like so many technology nerds, I downloaded Blender, installed it on my computer, tinkered with it for a few minutes and then went back to using my other 3D software instead. But for some reason, the idea of Blender never truly left me. Maybe I saw the potential in spite of the flaws. Or maybe the goal of powerful, open, and free software resonated with me on some deep level.

Every so often, I would repeat the cycle. Download, install, tinker, and then discard Blender. Admittedly, each iteration was better than the one before, but never quite ready. Until it was.

Looking back at it now, I notice that my Blender download rituals repeated with ever-narrowing frequency. At first, it was every two years, then every year, then every six months, then every two or three. This pace eventually hastened to the point that I was updating my installations of the software every morning. Yes, the program changes that often with what are called "nightly builds." By then, Blender had entirely replaced my previously-preferred primary 3D development tool.

Point-releases come along every six months or so, bearing cool new features and improved workflows. And every morning – like clockwork – fresh updates arrive to pick minor nits or to shuffle options around.

As awesome as it is watching a powerful tool become even more so in real-time, teaching 3D technology skills to students on top of an ever-evolving development platform is daunting. It almost feels like riding a bicycle downhill while it is being re-configured into an e-bike. Sometimes the training videos I create for my classes are obsoleted by better Blender tools before I finish a series based on the previous version. Just this month, SAC's 2020 3D Summer camp started the same week an important Blender update released. And the improvements almost demanded I re-make some of that material.

Like Blender, we too, are also constantly changing. Major milestones in our lives – both the leaps forward and the unexpected setbacks – all serve to mark our passage through time. We often overlook the everyday tweaks to our character and condition, but those minor changes also refine us into who we are becoming.

So, where are we on the upgrade path of our lives? ▲

PROJECTS:
SPELEO MYSTERIES SOLVED

by **Aaron Ellis**

Among the many benefits of working with the U.S. Department of Education grants program at San Antonio College are the opportunities for adventure that emerge from time to time. While most often our projects keep us indoors, on rare occasions, we get to head out – and sometimes down – to new worlds of discovery.

Over 20 years ago, Dr. George Veni, a former San Antonio College alumnus and now the director of the National Cave and Karst Research Institute focused on a specific speleothem (or cave deposit) for his Master's thesis. He suspected that one particular cave wall inside Cave Without A Name in Boerne, Texas might be a scalloped speleothem.

When viewed from cross-section, once-submerged scalloped deposits resemble ocean wave contours. They feature gradual convex cresting, followed by a drop and a shallow concavity before repeating the pattern along the length of the structure.

Unfortunately, at the time, Dr. Veni was unable to prove conclusively that the wall was or wasn't scalloped. Many years later, after a speaking engagement at his alma-mater, a chance meeting, and subsequent e-mail discussion of our seemingly-unrelated disciplines of study, we agreed to put 3D scanning technology to the task of analysing Dr. Veni's mysterious cave wall.

While our team had scanned cave formations before using a hand scanner on small cave deposits, this would be the first time we attempted to capture surface details of such a large swath of cavernous geometry using traditional techniques.

Photogrammetric 3D scanning works best on non-reflective surfaces with even, diffused lighting instead of harsh or worse, very dim illumination. However, Cave Without A Name is a commercial show cave with dramatic lighting arrangements. Also, as a cave with 100% year-round humidity, many surfaces continually glisten with moisture.

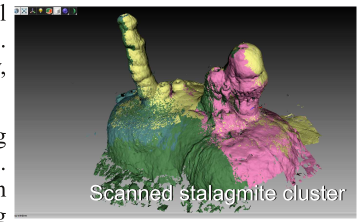
To get the best capture of the nearly 70-foot-long section of wall in those conditions was a challenge. As in other scans, we set up tracking markers in various spots along the wall that our scanning software (then Agisoft PhotoScan) could use for triangulating surface geometries. These fixed points of reference are typically angular shapes with colors that contrast well against the subject being scanned.

The scan required a little over 100 photographs of the wall and the immediate surroundings from many angles. Low and medium heights were easy to acquire, but for such a large artifact as a 20+ foot cave wall, a ladder was needed for some of the shots.

After a few brief pauses in photography as paying visitors toured the cave, all of the images were finally captured. A few weeks later, once the photographs were processed and the resulting 3D model was repaired of all its erroneous data, I submitted a digital version of the cave wall to Dr. Veni along with cross-section cuts of the surface.

Dr. Veni wrote at the time "there is no doubt that scallops really are there. They are distinct in each cut." Eventually, the results of our collaboration were also used in presentations by the Geologic Resources Division of the U.S. National Parks Service. Additional projects have confirmed that 3D scanning is a great tool for speleological research. ▲

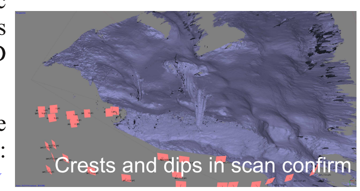
Note: to view an online interactive 3D model of the scalloped cave wall featured in this article, visit: https://sketchfab.com/aellis43/collections/speleology



Scanned stalagmite cluster

Rendered stalagmite cluster

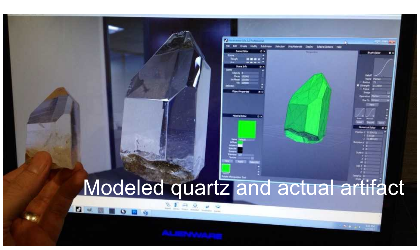
Scalloped cave wall or not?



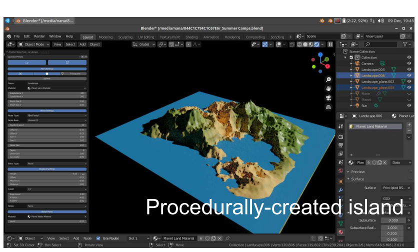
Crests and dips in scan confirm

NEWS:
CAMP MAKES-A-LOT BEGINS ONLINE SUMMER CAMP ACTIVITIES AT SAC

by **FACET Staff**



Modeled quartz and actual artifact



Procedurally-created island

Traditionally, the month of June marks the beginning of Summer camp activities around the country as children converge to make messes, masterpieces, and memories together. As mentioned in the April issue of FACET, San Antonio College's Summer camp this year is very different from previous offerings.

The current curriculum deviates primarily in delivery format but also with some changes in content as well. Each of the six skill disciplines is presented through one or more pre-recorded video lessons that discuss the topic, introduce the relevant tools, and then demonstrate the associated skills.

At present, our team has released four out of eight videos covering some of the six major 3D technology disciplines. Scanning, printing, terraining and an introduction to visualization are now available on our YouTube channel. The remaining videos for scene setup, simple animation, sculpting, and modeling will go online in July at a pace of roughly one per week.

Camp activities so far have included scanning real-world artifacts like rocks, toys, and rooms; simulating the 3D slicing and printing of a cartoon monkey face and a dinosaur using cardboard and glue; and designing planets and mountains. Future activities will include making virtual doughnuts with sprinkles, making smoke simulations, sculpting monsters and modeling vehicles.

Nearly 70 children have signed up for our free 3D Summer camp program. Additional slots are still available for parents who wish to enroll their kids. ▲

Note: for more information about Camp Makes-A-Lot, visit our project web site and join the fun: https://www.alamo.edu/sac/experience-sac/community/summer-camps/camp-makes-a-lot-3d-summer-camp/

IDEAS:
EQUAL APPLICATION UNDER THE LAWS OF LEARNING

by **Aaron Ellis**

In the early 1900s, psychologist and educator John Dewey emphasized the importance of "learning by doing." That idea has been a recurring theme in the pages of FACET Monthly since the begining of the publication.

While we all have different learning styles, there are some universal truths that apply to sentient beings. One of those is work, or as Edward L. Thorndike called it, "exercise."

Just as the building up of muscle is accomplished though the application of physical work to stress tissue and spur growth, in the educational realm, knowledge aquired through intellectual exertion and struggle expands learning.

All the textbooks, tutorials, and stack machines in the world are useless if they go unused. As someone who teaches and creates training videos, I cannot help but notice when students are not putting in the work and when video view counts remain low. Those indicators truly are linked.

Effort that results in failure, followed by informed and renewed effort leads in an upward spiral toward eventual success. This cycle of attainment remains true in nearly every endeavor of life. But lapses in any of these stages interrupts our own epic narratives of achievment.

I have focused most in these pages on the exercise, the attempt, or the direct application of skills, but according to Thorndike and his successors, there are other laws of learning to consider.

Are we ready for learning? If we stay up at all hours, ingest only junk, and constantly flit about from one frivolity to another, we hinder our own exceptional advancement. Focused minds and healthy, rested, and well-nourished bodies are fertile soil for discovery.

Are we motivated and rewarded? Athletes are said to experience a natural neurochemical release known as "runner's high." Wrestling with and overcoming a troublesome skill challenge can also be a rush in itself. Strong connections between internal reward and learning encourage continual growth.

Finally, ordered, recently repeated, intense, and free (as in liberty) learning experiences round out these universal learning truths.

What would happen if we all pursued worthy goals with purpose? ▲

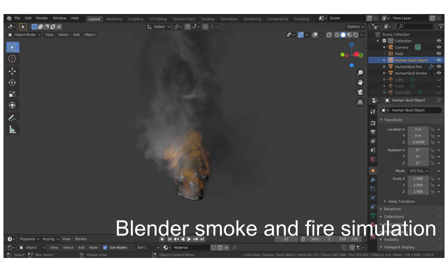
3DIVERSIONS:
PHUN WITH PHLUIDS?

by **Aaron Ellis**

I have a confession to make. This month's 3Diversions topic is not really my thing. While I enjoy most 3D technology topics, there are some aspects of it that really get on my nerves. Character animation, for example, makes me want to pull my hair out. And fluid simulation – with either liquid or gas effects – also bugs me. While I can happily spend hours modeling a steam-punk glider or tweaking material nodes for a scratched-up monkey robot like the one in this issue, finding the patience to construct realistic oceans or clouds is a challenge.

Fortunately, not everyone shares this aversion. After all, someone has to make the explosions and storms we see in Hollywood films. If you are reading this article and are truly mesmerized by this most organic of 3D processes, continue on.

When setting up rigid-body physics simulations like the ones shown last month, everything mostly makes sense. Select an object in a scene, assign properties for mass, and bounciness and then hit play to watch it all fall. There is a bit of unpredictability in how far something rolls or which side lands facing up, but things generally turn out as expected. But with fluid physics simulations, all bets are off. Like Kurt Russell said in *Backdraft*, fire "is a living thing." Water and smoke are too, by the way. All of these are, at their core, difficult to anticipate. This is because they are moved most by the unseen forces of gravity, wind, heat, and pressure.



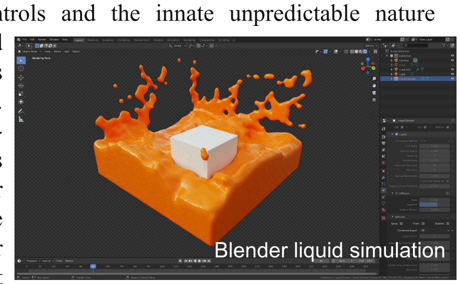
Blender smoke and fire simulation

One of the first things to learn about fluid simulations is that they are computationally intense and slow to calculate due to the interactions of millions of particles and droplets in a scene. Blender requires a special object called a domain (just a box) – where all of the fluid or gas movements take place – just to keep the math manageable. Whenever tendrils of virtual cloud or splashes of digital liquid reach the limits of a domain box, they bounce off or flow in a different direction.

Initiating a fluid sim in Blender is easy enough. Just select an object (like a basic cube) and click the Object, Quick Effects, and Quick Smoke or Quick Liquid from the viewport menu. A rectangular box (the domain) appears and surrounds the selected object, which, itself is wreathed in simulated smoke or filled with faked particles of liquid.

From there, we can add obstacles to the scene in standard fashion, but each new element is invisible to the simulation calculations until it is added to the domain using the Physics tab in Blender's Properties panel. We can also add hidden forces like wind and turbulence to the scene to make things even more interesting. Each new object or effect adds tens of new options and thousands of new calculations to the finished animation.

With all of these controls and the innate unpredictable nature mentioned earlier, no fluid simulation ever works as desired the first time. Each requires multiple re-adjustments, and minutes or hours of waiting for calculations to complete between attempts in order to get all of the details just right. While this level of fiddly-ness isn't for me, I must say that watching a successful water or smoke sim play on screen is inspiring.



Blender liquid simulation

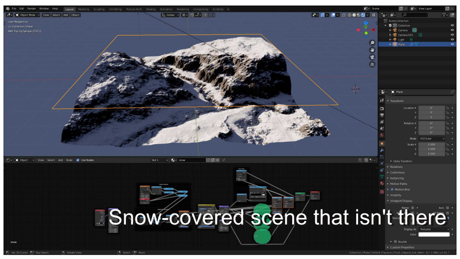
If fluid physics simulations are not quite your cup of tea, then maybe next month's 3Diversions article will be more attractive. In July we will tame the twisted topic of digital hair and fur. ▲

TECHNIQUES:
MATERIAL EYES, Pt. 3

by **FACET Staff**

Over the past few issues of FACET, we have hyped-up the materials system in Blender as a magical framework of creation while demonstrating more mundane uses for coloring cubes and patterning faces. There were also scattered references to mysterious tools called nodes. Well, this month we finally get a formal introduction.

In standard Blender material development, we select a shader (or material type) and then adjust a handful of parameters for color, roughness, specularity, etc. There are twenty different base shaders, ranging from the generic to the highly specialized. It is always important to select the one correct shader for the material effects we are trying to achieve.



Snow-covered scene that isn't there

The inclusion of nodes, however, alters that limitation. Nodes still use material types, but instead of just relying on only one shader, nodes allow them to be mixed and matched in complex arrangements. Also, nodes expand the ability to adjust shaders by moving beyond simple numeric data entry and color selection to allow for influence curves and proximity affectors. Not only that, but nodes can even reshape the perceived geometry of other objects with ease.

Just as nouns and verbs can be modified by adjectives and adverbs, the nodes system allows shaders to be tweaked by external controls. As we learned last month, a single face on a cube can be assigned a red colored material. But if nodes are used, that same face could instead be assigned a red and yellow striped pattern and then rotated to a 45 degree diagonal angle on a particular axis.

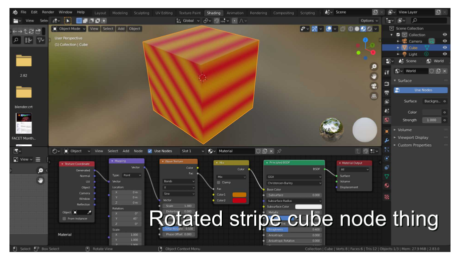
Nodes in Blender can be crafted to achieve just about anything. What if you wanted to create a rocky valley with a light dusting of snow on top using just random number generators and programmable image manipulation algorithms to displace (or deform) a very plain plane? Yes, nodes can do that and almost half a gazillion other things.

With all of the nodes that exist in Blender, it is important to note that each has a specific purpose. One node might only apply brightness and contrast settings to an image. Another might make an object glow. Still another might mix those two nodes together in such a way that only certain parts of the object glow and only at certain times during an animation sequence. These disparate nodes are connected by and at special input and output points called sockets.

To get ready for our very first node-based materializing project, we should probably start up a brand new Blender 2.8x instance. The opening scene will include a simple default cube. This is exactly what we need to begin, but we are not yet where we need to be. At startup, Blender automatically jumps into the Layout workspace. However, on the very top menu bar, you should see another option called Shading. Click that to switch to the Shading (or material editing) workspace.

Once there, you should notice a separate window near the bottom third of the screen with a couple of boxes (nodes) connected by lines (noodles) and attached at opposing points (sockets). You should also find another menu bar dedicated to that node-editing window. That is the one we want. And the most important option on that menu bar (for this activity) is the Add menu option.

Within the Add menu can be found a handful of useful node items. In addition to the Material Output and Principled BSDF, see if you can use the bottom-most Add menu to drop in a Mix RGB node (from the Color sub-menu), then a Wave Texture node (from the Texture sub-menu), a Mapping node (from the Vector sub-menu), and finally a Texture Coordinates node (from the Input sub-menu). If you were able to follow those steps correctly, then the tasks that come next should be super-easy. Just connect the proper input and output sockets from each of the nodes as shown in the screen-captured image here. It is generally a good idea to connect like-colored sockets together between nodes. Also, if you want to rotate your stripes, just change the Y rotation value to 45.



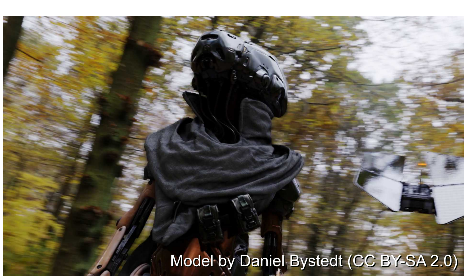
Rotated stripe cube node thing

That's it for this introduction to editing object materials in Blender 2.8x. Feel free to tinker with the settings here or try out other nodes. ▲

Note: to see some examples of truly mind-blowing node-editing work from last year's Nodevember nerd challenge on Twitter, visit: https://twitter.com/nodevemberio?lang=en

2020 SUMMER CAMPS:

San Antonio College is hosting 3D Technologies Summer Camps for teenagers during June and July of 2020. The June camps will be dedicated to 13 and 14-year-old students while the July camps will host 15, 16, and 17-year-olds. Campers will learn the basics of 3D visualization and animation, modeling mechanical objects, sculpting organic creatures, creating believable landscapes, scanning artifacts and 'printing' small items. Camp enrollment is free, but space is limited. For more information, contact us by e-mail at: aellis43@alamo.edu



Model by Daniel Bystedt (CC BY-SA 2.0)