Visualization Challenge Abstracts

Title: Polarization-dependent resonances in nanoparticle line patches

Author(s): Danqing Wang PhD candidate danqingwang2018@u.northwestern.edu

School/Dept.: Applied Physics program

Abstract:

This animation shows the polarization-dependent resonances of gold nanoparticle (NP) line patches. Multiple resonances were observed in hierarchical NP arrays influenced by nano-scale NP periodicity and microscale patch periodicity. This symmetry-breaking structure of line patches, however, shows polarization-dependent optical properties and different coupling along the x and y directions.

I used Adobe Illustrator to put together the spectra at different light polarization angle and stack them in Photoshop for animation. In order to present the scientific origin more effectively, different spectra were plotted in different colors and the 3D plotting provide rich information of spectra evolvement. As angle increased from 0° to 90°, the narrow resonance at shorter wavelength maintained its location and amplitude but a new resonance at longer wavelength gradually emerged and increased in intensity. This is important in differentiating the origin of longer wavelength mode from patch periodicity. Instead of a steady illustration, this animation captures the resonance evolution more clearly.

Title:

Author(s): Antoine A Emery, PhD candidate, antoineemery2012@u.northwestern.edu

School/Dept.: Materials Science and Engineering

Abstract:

Network graph representing 383 thermodynamically stable ABO3 perovskites calculated from all 5,329 possible combinations of A and B atoms using quantum mechanical methods. This network allows us to determine which elements react with each other to form compounds that can be synthesized in a lab. Each line represents a stable compound while each dot is an element on either the A- or B-site. Elements are clustered and colored by group (column) of the periodic table and their size is proportional to the number of lines connected to them. The color of each line is a mix between the color of the two dots they connect.

We can see that rare earths react with 3d transition metals to form several different perovskites, as observed experimentally. More interestingly, several unexplored compounds are predicted to be stable and present new avenues for new materials synthesis and discovery for a variety of applications such as piezoelectrics and water splitting for hydrogen production using sunlight. Gephi was used in conjunction with matplotlib to create this illustration.
Title: Obesity: Escalating Costs, Socioeconomics and Geography

Author(s):
James Herbick Jamesherbick2017@u.northwestern.edu
Sandra Castillo sancastillo@hotmail.com
Christi Giroux, ChrisGiroux@u.northwestern.edu
Kristine Palmer kristinescanlan2017@u.northwestern.edu
Andrew Vignes andrewvignes2016@u.northwestern.edu

School/Dept.: School of Professional Studies M.S. in Predictive Analytics Program

Abstract:
The Health and Fitness group focused its research and analysis on the complex factors that contribute to the United States obesity epidemic. Obesity is not only a serious threat to our country’s overall health, but it also carries significant healthcare costs. There are many variables to consider when examining this problem. The Health and Fitness group focused on the following: socioeconomic factors, health care costs and exercise, diet/nutrition, and chronic diseases.

Title: Thin Film Crystallization under Constant Nucleation Rate

Author(s): Mahyar M. Moghadam, Postdoc, Mahyar.moghadam@northwestern.edu

School/Dept.: Materials Science & Engineering, Voorhees group

Abstract:
We employed the level-set method to simulate transformation from amorphous state to crystalline structure in thin film through nucleation and growth processes. Presented animation illustrates how nuclei appear on the surfaces under constant nucleation rate. Each nucleus grows isotropically before stops at the point of contact to form a grain boundary. Nucleation rate and interface growth velocity are parameters that can control kinetics of this transformation. Results of this simulation used to address the effects of film thickness and heterogeneous nucleation on kinetics behavior of thin film crystallization and revealed new insight on final grain distribution. All visualization frames are generated by iso-surface command in Matlab over the course of simulation and then rendered as an animation in ImageJ software.
**Title:** Surface Shape Studies of the Art of Paul Gauguin

**Author(s):** Nathan Matsuda PhD Candidate nathanmatsuda@u.northwestern.edu

**School/Dept.:** EECS

**Abstract:**

This animation depicts the process of using photometric stereo techniques to inspect fine surface structure independently from the albedo, or color, contributed by pigments in a painting or print. In this example, the painting in question is a monotype print by Paul Gauguin, titled “Nativity”, I studied in collaboration with Prof. Ollie Cossairt's group in the Computational Photography Lab and the NU-ACCESS partnership with the Art Institute of Chicago. Our group performed data capture and processing during the project, working with conservators and art historians to ensure that the methods we used would help in revealing new information about the artist's processes. Part of this process included developing visualization strategies for clearly communicating the nature of the data being collected to a wider, non-technical cultural heritage audience. This animation was part of a longer explanatory video I produced and edited for this purpose.

My starting point for this visualization was the quantitative experimental data captured during the study. The final output from our processing algorithm consists of a lighting-free color map (the object's albedo) and height map (the object's shape). Because the level of detail provided by this technique is extremely fine, I chose to focus on a region of interest a few centimeters wide in the center of the print. Using open-source 3D graphics package Blender, I prepared geometry for the full print, to be texture mapped with a photo, and the inset, to be texture mapped and displaced by the experimental data. In the first half of the animation I lifted out the inset and then quickly exaggerated the vertical displacement of the surface. The team decided that we wanted to represent the idea of 'pulling away' the color as literally as possible, so I set up the color-mapped inset surface as a cloth simulation. Unlike an abstract dissolve or wipe transition, pulling the surface away in this manner shows relationship between the color and underlying structure in a physically understandable way.

After rendering the 3D imagery out from Blender, I added some final 2D touches in compositing software Nuke to help solidify the viewer's sense of scale. First, I animated cut lines and schematic anchors relating the inset edges to their original positions in the larger print. Then I animated tick marks during the height map exaggeration to visually reinforce the change in scale. I added a shallow depth of field pass to mimick a macro lens, providing an intuitive sense of smallness to the whole scene. Lastly I performed a color correction pass to qualitatively match the rendered colors to the way the print appears in person.

The full video, along with the publication and other information about the project, can be found at http://compphotolab.northwestern.edu/project/gauguin-surface-shape-studies-of-the-art-of-paul-gauguin

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