Flow

Flow

Julie Theriot and Fred Soo

Jeff Clark

Cedric Kiefer and Daniel Franke

Kristian Kloeckl

NASA/Goddard Space Flight Center Scientific
Visualization Studio

Pace Digital Gallery

Nov 26th – Dec 20th, 2012

Mon – Thur : 12:00 – 5:00 PM

Francis T. Marchese, Curator

Flow exhibits five computer animations created by visualizers working across a variety of disciplines who are concerned with the movement of matter, information, and the intersection of the two. Their videos represent data either gathered through experiment, or generated by computer simulation, that illustrate motion at a range of topographical and time scales, from minutes for bacteria to years for the Earth's ocean currents.
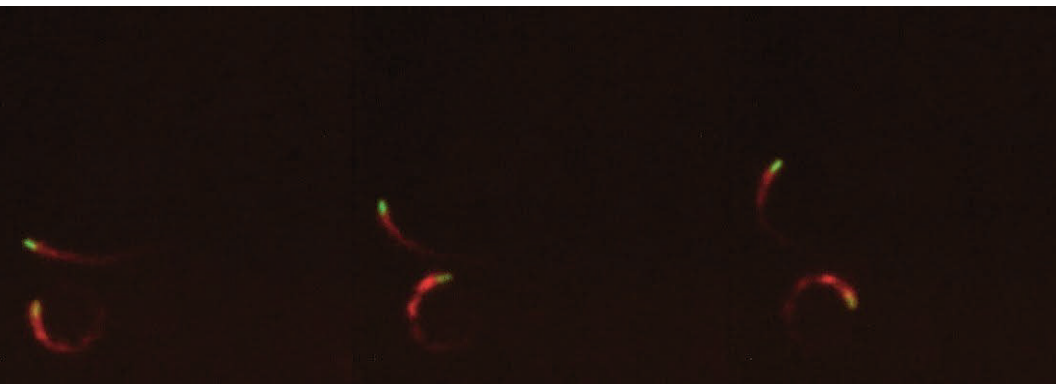
Bacteria may move in circles, weaving S-curves, straight lines, and seemingly random "dances." Julie Theriot and Fred Soo's video *Listeria Motility* captures these ballet motions of the bacterial pathogen *Listeria monocytogenes,* as it is propelled through a host cell's cytoplasm at approximately 75 nm/sec, rendering paths as red, glowing, and sinuous tails. In Jeff Clark's *Movement in Manhattan,* the trajectories created by successive geolocated positions of tweets from mobile phone users are imaged as comets that streak about the midtown Manhattan gridiron. The explosive rise and fall in the number of tweets over the course of a day are documented in a one minute video that exposes the chaotic dynamic. A more orchestrated dynamism may be seen in Cedric Kiefer and Daniel Franke's video *Unnamed Soundsculpture,* where the dancer's interpretive body movements of a musical score are transmuted into an affecting sound sculpture in which thousands of beads, digitally attached to and immersing the dancer's figure, ebb and flow through space with every move. Kristian Kloeckl's *Trains in Time* video tracks the flow of trains on the French National Railway Corporation's (SNCF) high speed rail network during the course of a week. Using real-time data from imbedded sensors throughout the SNCF track network, it highlights those trains that are behind schedule, impeding the flow of thousands of passengers through the system. Finally, *Perpetual Ocean* by the NASA/Goddard Space Flight Center Scientific Visualization Studio is a visualization of the flow of tens of thousands of the Earth's ocean currents synthesized from data gathered over an one and a half year period. Combining observational data with mathematical model, the video provides a realistic illustration of both the order and the chaos of the circulating waters that populate Earth's ocean.

Listeria Motility

The *Listeria Motility* video presents two Listeria monocytogenes bacteria (green) in motion, each with a red comet tail highlighting its traversed path. This work was produced by Fred Soo as part of his PhD research with Dr. Julie Theriot at Stanford University to understand how polymerization of the protein actin drives the movement of bacterial pathogens. Actin filaments are made up of protein monomers - individual building blocks that can be linked together to form chains through polymerization. As these filaments grow, they exert force on Listeria monocytogenes, pushing it forward from the outside, causing the bacterium to rocket ahead, leaving behind a comet tail of short tangled actin-filaments which shrink (depolymerize) over time.

Listeria Motility results from Soo and Theriot's research into the development of new software designed to automatically track large numbers of bacteria undergoing actin-based motility. Beginning with an image sequence of bacterial motion, this software calculated bacteria speed, average actin density, and average path curvature. The centroid position of the bacterium for every frame in the movie was then superimposed on a single pseudo-colored fluorescence image of the bacterium's body (green) and its actin-containing comet tail (red). The bacterium's actin comet-tail lies along the previously traversed path, the fluorescence intensity of which decreases with distance from the end of the bacterium. This provides a streaking effect seen in the video.
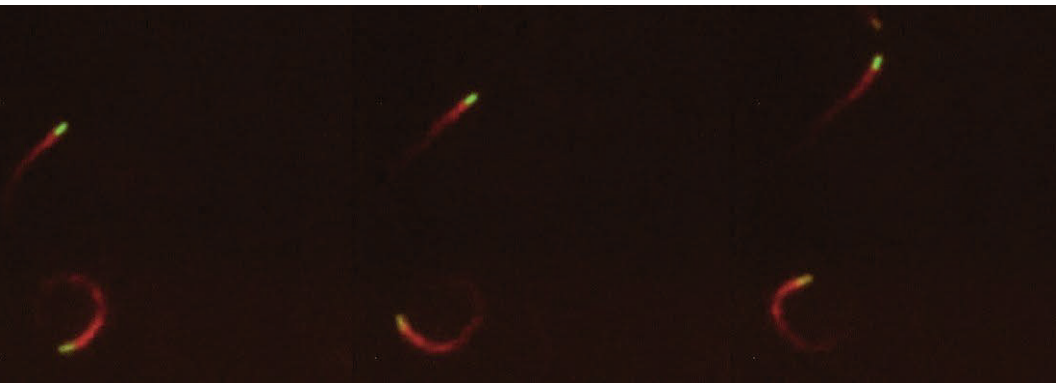
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Reference

Soo FS, Theriot JA, 2005, "Large-scale quantitative analysis of sources of variation in the actin polymerization-based movement of Listeria monocytogenes." *Biophys J.* 89(1): 703-23.
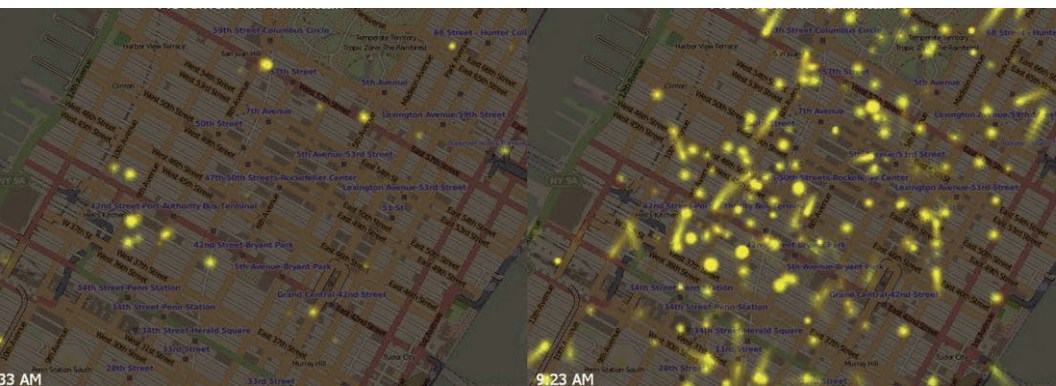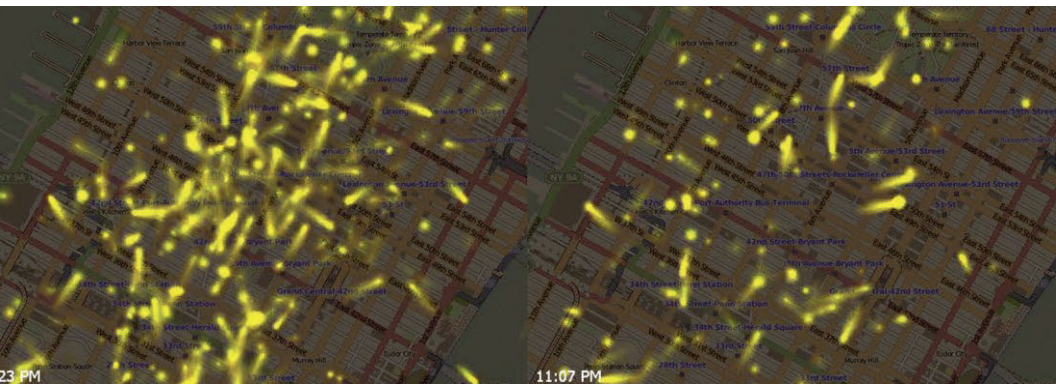
Movement in Manhattan

Movement in Manhattan explores the flow of people from approximately 34th Street to Central Park South. Geolocated tweets were used to track movement of individuals. The video represents each tweet as a comet streaking across Manhattan, compressing 24 hours of tweets taken Monday, April 30th, 2012 into a one minute video.

Jeff Clark is a professional software developer with interests in data mining, statistical analysis, and visualization. His video is an experiment in illustrating the uncertainty in the flow of information. His initial inspiration for this project came from Fernanda Viegas and Martin Wattenberg's interactive, real-time *Wind Map*[1] of the United States, but the final rendering in *Movement in Manhattan* was inspired by Michael Kreil's *Fireflies*[2] video of the movement of 881 iPhones in Europe.

Geolocated tweets for *Movement in Manhattan* were collected with the Twitter4J[3] programming library, which used code written in the Processing[4] programming language. Code from a flow field sample by Daniel Shiffman[5] was used as a starting point to create the flow maps. The background map is from OpenStreetMap[6].
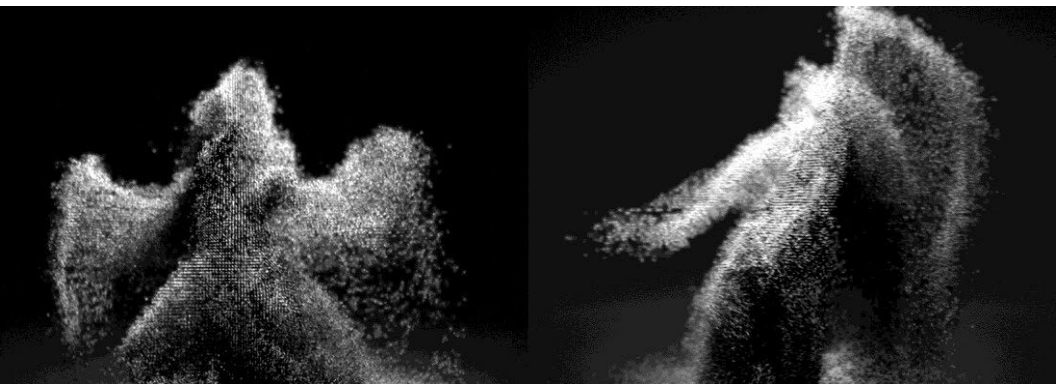
2012

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References

[1]Viegas F and Wattenberg M, "Wind Map." Retrieved Oct. 24, 2012
from http://hint.fm/wind/.

[2]Kreil M, "Fireflies HD." Retrieved Oct. 24, 2012 from
http://crowdflow.net/2011/07/12/fireflies-hd/.

[3]*Twitter4J*. Retrieved Oct. 24, 2012 from
http://twitter4j.org/en/index.html.

[4]*Processing*. Retrieved Oct. 24, 2012 from http://processing.org/.

[5]Shiffman D*, "*Flow Field." Retrieved Oct. 24, 2012 from
http://www.shiffman.net/itp/classes/nature/week06_s09/flowfield/.

[6]*OpenStreetMap*. Retrieved Oct. 24, 2012 from
http://www.openstreetmap.org/.

Unnamed Soundsculpture

Cedric Kiefer works in generative design, a formulism in which design output is created by a set of rules or an algorithm; and Daniel Franke is an artist, designer, and music video director. Together they created *Unnamed Soundsculpture,* a mesmerizing video based on recorded motion data of the dancer Laura Keil as she interpreted the musical piece *Kreukeltape* by Machinenfabriek. Depth cameras captured both the dancer and the three-dimensional sonic space in which she performed, providing the foundation for a point cloud digital representation of the dancer's body. This model was fed into a 3D animation program in which a virtual camera could be positioned at will, and react to the recorded sound, so as to drive its motion, thus enhancing the expressive dance performance.

Three Microsoft® Kinect® depth cameras captured the dancer's movements. The intersection of these images was later assembled into a file containing a three-dimensional volume composed of a 22,000 point cloud digital representation of the dancer's body. This dataset was exported to Krakatoa®, a volumetric particle manipulation and rendering toolkit developed by Thinkbox Software. Finally, the Krakatoa particle files were loaded into Autodesk® 3ds Max® for further rendering and creation of the 3D scenes, including camera movement, that was controlled by the audio channel.

2012

[1]Cedric Kiefer
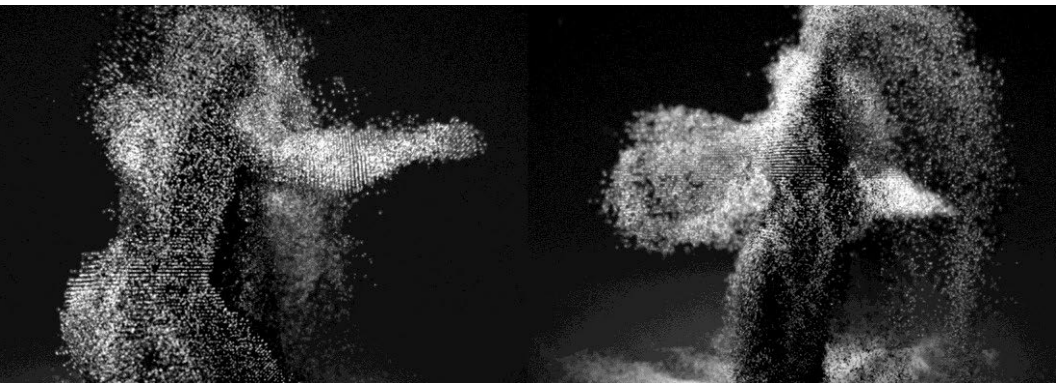[2]Daniel Franke

In cooperation with:
Laura Keil (Dancer)

http://www.onformative.com/work/unnamed-soundsculpture/

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[2]ChopChop
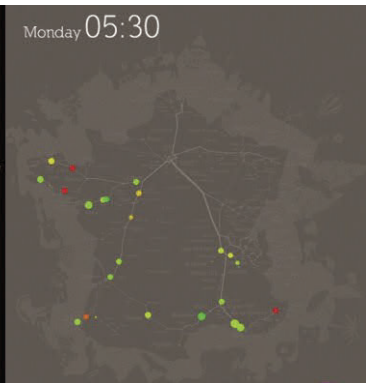info@wearechopchop.com

Trains in Time

Trains in Time was created by Kristian Kloeckl, an industrial designer, and his team at MIT's Senseable City project in collaboration with SNCF (Société Nationale des Chemins de fer français), the French National Railway Corporation's division for research and innovation to investigate new ways of gaining insight into how people access different parts of France using the country's high speed railway system.

Trains in Time maps the location and number of passengers who are directly affected by delays in a rail system. It visualizes train delays by combining a simple iconography of shape, size, and color, to pinpoint the position of each train and characterize its degree of lateness at any given moment in time on a live map of SNCF's train network. With this visualization a rail operator can quickly understand where many passengers are affected by train delays, and utilize this information to take appropriate action, ultimately limiting delay per passenger, and increasing overall passenger satisfaction.
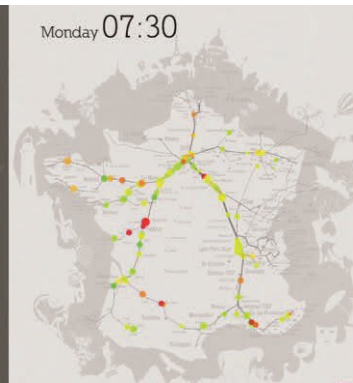
2011

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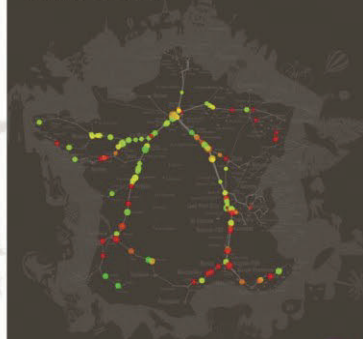77 Massachusetts Avenue
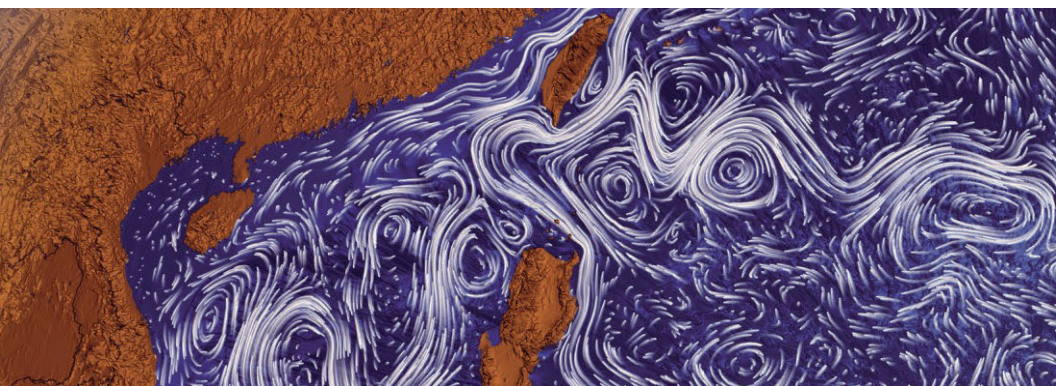Cambridge, MA 02139 USA

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Perpetual Ocean

Perpetual Ocean is a visualization of the tens of thousands of ocean currents covering the time period from June 2005 through December 2007. *Perpetual Ocean* combines observational data with advanced mathematical modeling supplied by the ECCO (Estimating the Circulation and Climate of the Ocean) project, a joint venture between the Massachusetts Institute of Technology and NASA's Jet Propulsion Laboratory in Pasadena, CA, that obtains realistic representations of ocean circulation evolution. This combination of data with theoretical models was among the largest computations of its kind, resorting to supercomputing resources provided by NASA's Ames Research Center in Moffett Field, CA. Data used by the ECCO project include: sea surface height, gravity, surface wind stress, sea surface temperature, sea ice concentration and velocity data, and temperature and salinity profiles.

The *Perpetual Ocean* animation was created by the NASA/Goddard Space Flight Center Scientific Visualization Studio. It began with a data set that directs three dimensional motions of the ocean currents. Virtual particles were dropped into the ocean, allowed to move along a current's path, and tracked over time. The animation was created by transforming virtual particles' histories into series of lines. A long line represents a particle that has moved relatively rapidly, while a short line signifies a particle that is nearly stationary. The resulting *Perpetual Ocean* video was generated by feeding this geometric data into Autodesk's® Maya® 3D animation software and finally rendering it with Pixar's® RenderMan®.
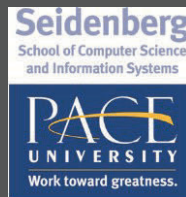
Pace Digital Gallery

About Us: Pace University's Digital Gallery is the combined initiative between Pace's Center for Advanced Media (CAM) and Digital Arts. It was inaugurated in Spring 2003 as a collaboration between the Seidenberg School of Computer Science and Information Systems and the Fine Arts Department.

Location: Located at 163 William Street, a few blocks from City Hall, The Brooklyn Bridge, and Wall Street, Pace's Digital Gallery is part of a vital downtown NYC art scene that includes historic architecture and national museums.
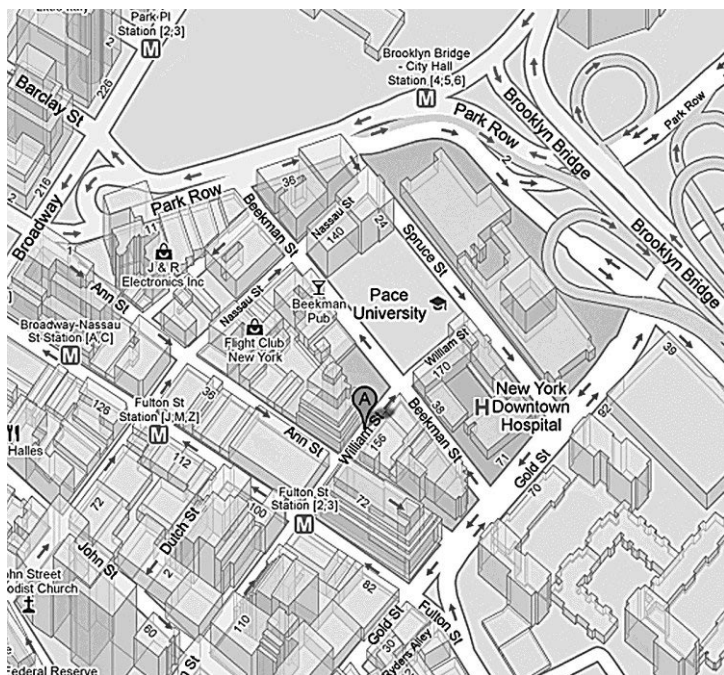
Mission: The goal of Pace's Digital Gallery's is to foster the creation and understanding of digital art for the benefit of Pace University, the surrounding community, and the general public. It furthers Pace University's commitment to educational excellence, diversity, and civic involvement by exhibiting curated work of leading digital artists, sponsoring lectures and symposia on digital art, and publishing materials for its documentation and promotion.

Website: www.pace.edu/DigitalGallery

Directors : Francis T. Marchese & Jillian Mcdonald

Department of Fine Arts

Pace Digital Gallery