Banff International Research Station
for Mathematical Innovation and Discovery

Mathematics: Muse, Maker, and Measure of the Arts
December 4-9, 2011

MEALS

*Breakfast (Buffet): 7:00 – 9:30 am, Sally Borden Building, Monday – Friday
*Lunch (Buffet): 11:30 am – 1:30 pm, Sally Borden Building, Monday – Friday
*Dinner (Buffet): 5:30 – 7:30 pm, Sally Borden Building, Sunday – Thursday
Coffee Breaks: As per daily schedule, in the foyer of the TransCanada Pipeline Pavilion (TCPL)
Please remember to scan your meal card at the host/hostess station in the dining room for each meal.

MEETING ROOMS

All lectures will be held in TransCanada Pipelines Pavilion (TCPL), Room 202. LCD projector and blackboards are available for presentations.

SCHEDULE

Sunday

16:00   Check-in begins (Front Desk – Professional Development Centre - open 24 hours)
17:30-19:30 Buffet Dinner
20:00   Informal gathering in 2nd floor lounge, Corbett Hall
             Beverages and small assortment of snacks are available on a cash honor system.

Monday

7:00-8:45   Breakfast
8:45-9:00   Introduction and Welcome by BIRS Station Manager, TCPL
9:00-10:00   Ingrid Daubechies, *Distinguishing the Hand of the Master?*
10:00-10:30 Coffee Break, TCPL
10:30-11:30 Reza Sarhangi, *Polyhedral Modularity in a Special Class of Decagram Based Interlocking Star Polygons*
11:30-13:00 Lunch
13:00-14:00 Guided Tour of The Banff Centre; meet in the 2nd floor lounge, Corbett Hall
14:00-15:00 Jason Brown, *The Mathematics Underlying Musical Mysteries*
15:00-15:30 Coffee Break, TCPL
15:30-16:30 Robert Moody, *TBA*
17:30-19:30 Dinner

Tuesday (Tentative)

7:00-9:00   Breakfast
9:00-10:00   David Mumford, *Synthesis via Random Wavelets*
10:00-10:30 Coffee Break, TCPL
10:30-11:30 Shannon Hughes, *Visual Stylometry on Impressionist Paintings for Artist Identification and Dating*
11:30 -11:45 Group Photo; meet on the front steps of Corbett Hall
11:45-13:30 Lunch
13:30-14:30 Stephane Jaffard, *Multifractal Analysis for Art Investigation, Part I: Mathematical*

Methods
14:30-15:00 Coffee Break, TCPL
15:00-16:00 Robert Schneider, *Proofs without Lyrics*
16:00-16:30 Break
16:30-17:30 Alice Major, *TBA*
17:30-19:30 Dinner

Wednesday (Tentative)

7:00-9:00 Breakfast
9:00-10:00 Free Time or Group Discussions
10:00-11:00 James Wang, *Automated Analysis of Paintings and Photographic Arts*

11:00-12:00 Patrice Abry, *Multifractal analysis for art investigation, Part II. Multifractal analysis at work on textures of paintings and drawings*

12:00-13:30 Lunch

Free Afternoon
17:30-19:30 Dinner

Thursday (Tentative)

7:00-9:00 Breakfast
9:00-10:00 Jim Coddington, *Decoding with Code: Technical Imaging in the Study of Art*
10:00-10:30 Coffee Break, TCPL
10:30-11:30 James Hughes, *Spatial Stylometry and the Psychophysics of Stylometry*
11:30-13:30 Lunch
13:30-14:30 Craig Kaplan, *TBA*
14:30-15:00 Coffee Break, TCPL
15:00-16:00 George Hart, *The Art Gallery at the Museum of Mathematics*
16:00-16:30 Break
16:30-17:30 Luke Wolcott, *Recent Stories from the Math-Art Frontier*
17:30-19:30 Dinner

Friday

7:00-9:00 Breakfast
9:00-10:00 Group Discussions
10:00-10:30 Coffee Break, TCPL
10:30-11:30 Group Discussions
11:30-13:30 Lunch

Checkout by 12 noon.

** 5-day workshop participants are welcome to use BIRS facilities (BIRS Coffee Lounge, TCPL and Reading Room) until 3 pm on Friday, although participants are still required to checkout of the guest rooms by 12 noon. **

Abstracts to follow in alphabetical order by last name of speaker.

Mathematics: Muse, Maker, and Measure of the Arts
December 4-9, 2011

ABSTRACTS

(in alphabetic order by speaker surname)

Speaker: Patrice Abry (ENS Lyon-CNRS)
Title: *Multifractal analysis for art investigation, Part II. Multifractal analysis at work on textures of paintings and drawings* (Joint work with S. Jaffard and H. Wendt.)
Abstract: In image processing, texture analysis is a both common and important issue. Multifractal analysis, that aims at characterizing the fluctuations of point wise regularity in a texture, is now considered as a tool of choice for texture analysis. In the present talk, it will be explained in what sense multifractal analysis is related to the scale invariance (or scaling) properties of the texture and multifractal analysis will therefore be briefly compared to other scaling analysis procedures. The potential, benefits and limitations of multifractal analysis for art investigations will be illustrated at work on three different data sets:
- A collection of originals and replicas, painted by the same artist, as a scientific experience and testbed (the Princeton experiment) ;
- Paintings by Van Gogh and contemporaries, with challenges in terms of dating Van Gogh's paintings or discriminating Van Gogh's from non Van Gogh's ;
- Drawings by Brueghel, with challenge in terms of discriminating originals from imitations.

Speaker: Jason Brown (Dalhousie University)
Title: *The Mathematics Underlying Musical Mysteries*
Abstract: Mathematics is the science of patterns, and patterns infuse music. Mathematics allows us to understand the aesthetics of music, that go on at both a conscious and subconscious level. In this talk we'll apply a variety of mathematics to discover why we love music the way we do, and to uncover mysteries hidden in the best of pop music.

Speaker: Jim Coddington (Museum of Modern Art)
Title: *Decoding With Code: Technical Imaging in the Study of Art*
Abstract: Technical imaging in the study of art has a long history, dating to Roentgen and the very early days of x-radiography. Over time more and more of the electromagnetic spectrum has been put to use to understand more about the materials, construction and creation of works of art. Developing these hardware-based solutions to investigative problems has been the principal focus of conservators and scientists over the decades. In recent years the use of image processing tools has increased, taking advantage of both existing archives of technical images as well as optimizing new data collected by increasingly sophisticated and sensitive imaging devices. This paper will touch on key technologies and examples of their use in the study of art, with a particular emphasis on modern and contemporary art. Areas of potential new research and development will also be discussed.

Speaker: Ingrid Daubechies (Duke University)
Title: *Distinguishing the Hand of the Master?*
Abstract: TBA

Speaker: George Hart (Museum of Mathematics)
Title: *The Art Gallery at the Museum of Mathematics*
Abstract: The Museum of Mathematics (MoMath) is scheduled to open in New York City in Fall, 2012. We have rented a 20,000 square foot space and are designing a variety of interactive, hands-on exhibits which emphasize the surprising, fun, and creative sides of mathematics. Our plans include 1,000 square feet of gallery space for temporary art exhibitions. We hope to display three or four shows per year in this art gallery.

The presentation will include an overview of MoMath's status, a summary of some of the exhibits planned, and an interactive discussion of questions relating to the art gallery. Ideas are most welcome on topics including: What sorts of mathematical art would have the greatest impact on the public? What curatorial process is best for selecting exhibit themes and artworks? What sorts of hands-on workshop activities might be paired with exhibitions to reinforce the mathematical ideas? How might we assess whether an art exhibition is effective at conveying mathematical ideas? What funding sources might be approached for sponsoring mathematical art exhibitions?

Speaker: Shannon Hughes (University of Colorado at Boulder)
Title: *Visual Stylometry on Impressionist Paintings for Artist Identification and Dating*
Abstract: Visual stylometry of art proposes to apply mathematical and statistical tools to high-resolution digital images of artwork to produce a quantitative description of each work's style or of the "stylistic distance" between works. The premise is that an artist's unique habitual physical movements while painting leave characteristic measurable stylistic features in the brushwork. Such quantitative descriptions of style may then assist art scholars in answering open art historical questions, including those of the work's authorship and date of creation if unknown. I will describe our recent work developing a new wavelet-HMT-Fisher-information measure of stylistic distance and show its application to artist identification and dating on the Van Gogh project dataset, consisting of very high-resolution photographs of over 130 impressionist paintings by Van Gogh and contemporaries.

Speaker: James Hughes (Dartmouth College)
Title: *Spatial stylometry and the psychophysics of stylometry*
Abstract: TBA

Speaker: Stephane Jaffard (Université Paris est Créteil)
Title: *Multifractal analysis for art investigation, Part 1: Mathematical methods* (joint work with P. Abry and H. Wendt)
Abstract: Unlike traditional fractal techniques, which usually associate one parameter to analyzed data (a fractal dimension) in order to perform their classification, multifractal analysis associates a whole function to the analyzed data: Their multifractal spectrum. This function describes the dimensions of all singularity sets of different intensities. In this first part, we will explain how wavelet decomposition techniques give access to a dual quantity, the "scaling function"; we will give function space interpretations of this function and derive some of their implications. We will investigate the benefits of using wavelet techniques, compared to more traditional, increment-based techniques, both from a mathematical and computational point of view. Finally we will give some insight on the mathematical justifications of this duality between the spectrum of singularities and the scaling function.

Speaker: Craig Kaplan (University of Waterloo)
Title: *TBA*
Abstract: TBA

Speaker: Alice Major (Independent)
Title: *TBA*
Abstract: TBA

Speaker: Robert Moody (University of Victoria)
Title: *TBA*
Abstract: TBA

Speaker: David Mumford (Brown University)
Title: *Synthesis via Random Wavelets*
Abstract: Among all random images, what characterizes natural images? Scale-invariance certainly but also the high kurtosis of all filter responses. This suggests a decomposition into basic primitives, textons or edges/bars/blobs or mother wavelets. We discuss one theory by me and Gidas and further developments by Morel, Gousseau and Alvarez. While the results still don't look much like natural scenes, some certainly resemble (to my untrained eye) the products of some well-known abstract artists.

Speaker: Reza Sarhangi (Towson University)
Title: *Polyhedral Modularity in a Special Class of Decagram Based Interlocking Star Polygons*
Abstract: The main effort in this presentation is to study a series of Persian mosaic designs that have been illustrated in scrolls or decorated the surfaces of ancient structures. The common element for the course of study in these designs is a special ten-pointed star polygon. This special concave polygon, which is called a decagram for convenience, is the dominant geometric shape of a series of polyhedral tessellations that all consist of the same common motifs. The decagram can be created through the rotation of two concentric congruent regular pentagons with a radial distance of 36° from each other's' central angles. However, to create a decagram-based interlocking pattern, a craftsman-mathematician needs to take careful steps to locate a fundamental region. The rectangular-shaped fundamental regions, which are constructed using radial grids, have different proportions for their dimensions. This presentation includes a few patterns that are considered aperiodic (quasiperiodic) tillings, in the language of modern mathematics.

Speaker: Robert Schneider (University of Kentucky)
Title: *Proofs Without Lyrics*
Abstract: TBA

Speaker: James Wang (Penn State University and NSF)
Title: *Automated Analysis of Paintings and Photographic Arts*
Abstract: TBA

Speaker: Luke Wolcott (University of Washington)
Title: *Recent Stories from the Math-Art Frontier*
Abstract: I will show and tell about several recent math-art collaborations. Media involved: illustration and dance, electronic pop music, and ritual performance. Themes explored: my PhD research in stable homotopy theory, the research mathematics experience, and negative-dimensional space.