IS&T International Symposium on
Electronic Imaging
SCIENCE AND TECHNOLOGY

29 January 2017 – 2 February 2017 • Burlingame, CA, USA

PROCEEDINGS

Human Vision and Electronic Imaging 2017

Editors: **Bernice E. Rogowitz,** Visual Perspectives (United States),
Thrasyvoulos N. Pappas, Northwestern University (United States),
Huib de Ridder, Technische Universiteit Delft (the Netherlands)

These papers represent the program of Electronic Imaging 2017,
held January 29 – February 2, 2017, at the Hyatt Regency San Francisco Airport in Burlingame, CA.

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ISSN 2470-1173
https://doi.org/10.2352/ISSN.2470-1173.2017.14.HVEI-A
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Human Vision and Electronic Imaging 2017

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Human Vision and Electronic Imaging 2017

Monday, January 30, 2017

Chair Opening Remarks
Session Chairs: Bernice Rogowitz, Visual Perspectives (United States), Thrasyvoulos Pappas, Northwestern University (United States), and Huib de Ridder, Delft University of Technology (the Netherlands)
9:00 – 9:10 am
Regency Ballroom B

Keynote 1: Human Vision - Unifying Theory from Peripheral Vision
Session Chair: Bernice Rogowitz, Visual Perspectives (United States)
9:10 – 10:00 am
Regency Ballroom B

8
Capacity limits and how the visual system copes with them (Invited), *Ruth Rosenholtz, MIT (United States)* [HVEI-111]

Ruth Rosenholtz is a Principal Research Scientist in the Dept. of Brain and Cognitive Sciences at MIT. Her lab studies human vision, including visual search, peripheral vision, perceptual organization, and the impact of visual clutter on task performance. Rosenholtz earned her PhD in electrical engineering and computer science, University of California at Berkeley (1994). Prior to MIT, she held research positions with the (Xerox) Palo Alto Research Center, NASA Ames, and with Utrecht University.

10:00 – 10:30 am Coffee Break

Special Session: Decoding Visual Semantics: Perceptual Modeling and Deep Learning
Session Chairs: Jan Koenderink, Katholieke University Leuven (Belgium), and Ruth Rosenholtz, MIT (United States)
10:30 am – 12:30 pm
Regency Ballroom B

10:30 24
Eidolons and capricious local sign (Invited), *Jan Koenderink[1], Andrea van Doorn[2], Matteo Valsecchi[3], Johan Wagemans[1], and Karl Gegenfurtner[3]; [1]Katholieke Universiteit Leuven (Belgium), [2]Utrecht Univerity (the Netherlands), and [3]Justus-Liebig University, Giessen (Germany)* [HVEI-112]

11:00 36
Methods and measurements to compare men against machines (Invited), *Felix Wichmann[1,2,3], David H. J. Janssen[1], Robert Geirhos[1], Guillermo Aguilar[4,5], Heiko H. Schütt[1,6], Marianne Maertens[4,5], and Matthias Bethge[2,7]; [1]Neural Information Processing Group, Universität Tübingen, [2]Bernstein Center for Computational Neuroscience, Tübingen, [3]Max-Planck-Institut für Intelligente Systems, Tübingen, [4]Faculty of Computer Science and Electrical Engineering, TU Berlin, [5]Bernstein Center for Computational Neuroscience, Berlin, [6]Department of Psychology, University of Potsdam, and [7]Centre for Integrative Neuroscience, Universität Tübingen (Germany)* [HVEI-113]

11:30
Perceptual and engineering implications of cascaded gain control models (Invited), *Eero Simoncelli[1], Valero Laparra[1,2], Johannes Ballé[1], and Alexander Berardino[1]; [1]New York University (United States) and [2]University of Valencia (Spain)* [HVEI-114]

12:00
Emerging visual representations in deep learning networks (Invited), *Aude Oliva, MIT (United States)* [HVEI-116]

12:30 – 2:00 pm Lunch Break

EI 2017 Opening Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm
Grand Peninsula Ballroom D

Giga-scale 3D computational microscopy, *Laura Waller, University of California, Berkeley (United States)*

Laura Waller is the Ted Van Duzer Endowed Assistant Professor of Electrical Engineering and Computer Sciences (EECS) at UC Berkeley. She is a Senior Fellow at the Berkeley Institute of Data Science, and received her BS (2004), MEng (2005), and PhD (2010) in EECS from the Massachusetts Institute of Technology (MIT). Waller's talk is on computational imaging methods for fast capture of gigapixel-scale 3D intensity and phase images in a commercial microscope that employs illumination-side and detection-side coding of angle (Fourier) space with simple hardware and fast acquisition. The result is high-resolution reconstructions across a large field-of-view, achieving high space-bandwith-time product.

3:00 – 3:30 pm Coffee Break

Keynote 2: Media Content Semantics - Transmitting Meaning
Session Chair: Thrasyvoulos Pappas, Northwestern University (United States)
3:30 – 4:20 pm
Regency Ballroom B

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Movies and meaning: From low-level features to mind reading (Invited), *Sergio Benini, University of Brescia (Italy)* [HVEI-117]

Sergio Benini received his MSc in electronic engineering (cum laude) at the University of Brescia (2000) with a thesis granted by Italian Academy of Science. Between '01 and '03 he was with Siemens Mobile Communications R&D. He received his PhD in information engineering from the University of Brescia (2006), working on video content analysis. During his PhD he spent one year in British Telecom Research, United Kingdom, working in the "Content & Coding Lab." Since 2005 he has been an Assistant Professor at the University of Brescia. In 2012, he co-founded Yonder, a spin-off company specialized in NLP, Machine Learning, and Cognitive Computing.

High Level Vision

Session Chair: Bernice Rogowitz, Visual Perspectives (United States)
4:20 – 4:40 pm
Regency Ballroom B

4:20 58
On the role of color in visual saliency, *Sergio Etchebehere[1] and Elena Fedorovskaya[2]; [1]University Jean Monnet Saint-Etienne (France) and [2]Rochester Institute of Technology (United States)* [HVEI-119]

DISCUSSION: From Low-Level Descriptors to Visual Semantics

4:40 – 5:40 pm
Regency Ballroom B

Every afternoon at HVEI, authors from the day's papers gather to participate in a dynamic discussion with the audience, moderated by the conference and session chairs. Since the papers and the participants represent diverse disciplines, these interactive sessions are exciting and provocative.

Symposium Welcome Reception
5:00 – 6:00 pm
Atrium

Human Vision and Electronic Imaging 2017 Banquet

Hosts: Bernice Rogowitz, Visual Perspectives (United States), Thrasyvoulos Pappas, Northwestern University (United States), and Huib de Ridder, Delft University of Technology (the Netherlands)

7:15 – 10:00 pm
Sandpebble C,D

Deep learning for gestalt and gestalt for deep learning (Invited), *Stella Yu, University of California, Berkeley (United States)*

Please join us for an exciting banquet presentation and the opportunity to interact with fellow colleagues and speakers, in an informal atmosphere. You can sign up for the Banquet now, when you register.

Tuesday, January 31, 2017

Human Vision and Stereoscopic Imaging JOINT SESSION

Session Chairs: Nicolas Holliman, University of Newcastle (United Kingdom), and Thrasyvoulos Pappas, Northwestern University (United States)

8:50 – 10:10 am
Grand Peninsula Ballroom D

This session is jointly sponsored by: Stereoscopic Displays and Applications XXVIII and Human Vision and Electronic Imaging 2017.

8:50 64
Depth-compressed expression for providing natural, visual experiences with integral 3D displays, *Yasuhito Sawahata and Toshiya Morita, Japan Broadcasting Corporation (Japan)* [HVEI-378]

9:10 70
Blind quality prediction of stereoscopic 3D images, *Jiheng Wang, Qingbo Wu, Abdul Rehman, Shiqi Wang, and Zhou Wang; University of Waterloo (Canada)* [HVEI-379]

9:30
Pseudo-haptic by stereoscopic images and effects on muscular activity, *Takashi Kawai[1], Fumiya Ohta[1], Sanghyun Kim[1], and Hiroyuki Morikawa[1,2]; [1]Waseda University and [2]Aoyama Gakuin University (Japan)* [SD&A-380]

9:50
The effects of proximity cues on visual comfort when viewing stereoscopic contents (JIST-first), *Yaohua Xie[1], Danli Wang[2], and Heng Qiao[3]; [1]Chinese Academy of Sciences, [2]Institute of Software, Chinese Academy of Sciences, and [3]Central University of Finance and Economics (China)* [SD&A-381]

10:00 am – 7:30 pm Industry Exhibition

10:10 – 10:40 am Coffee Break

Emerging Issues in Perceptual Image Quality

Session Chair: Huib de Ridder, Delft University of Technology (the Netherlands)

10:40 am – 12:40 pm
Regency Ballroom B

10:40 77
Interactions between saliency and utility, *Edward Scott and Sheila Hemami, Northeastern University (United States)* [HVEI-120]

11:00 85
Perceptual evaluation of psychovisual rate-distortion enhancement in video coding, *Zhengfang Duanmu, Kai Zeng, Zhou Wang, and Mahzar Eisapour, University of Waterloo (Canada)* [HVEI-121]

11:20 91
Balancing Type I errors and statistical power in video quality assessment, *Kjell Brunnstrom[1,2] and Marcus Barkowsky[3]; [1]Acreo Swedish ICT AB (Sweden), [2]Mid Sweden University (Sweden), and [3]University of Nantes (France)* [HVEI-122]

11:40 97
On the perceptual factors underlying the quality of post-compression enhancement of textures, *Yusizwan Yaacob, Yi Zhang, and Damon Chandler, Shizuoka University (Japan)* [HVEI-123]

12:00 104
Do gaze disruptions indicate the perceived quality of non-uniformly coded natural scenes?, *Yashas Rai and Patrick Le Callet, University of Nantes (France)* [HVEI-124]

12:20 110
Subjective evaluation of distortions in first-person videos, *Chen Bai and Amy Reibman, Purdue University (United States)* [HVEI-125]

12:40 – 2:00 pm Lunch Break

EI 2017 Tuesday Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm
Grand Peninsula Ballroom D

VR 2.0: Making virtual reality better than reality, *Gordon Wetzstein, Stanford University (United States)*

Gordon Wetzstein is an Assistant Professor of Electrical Engineering and, by courtesy, of Computer Science, at Stanford University, and leads the Stanford Computational Imaging Group. He received a PhD in computer science from the University of British Columbia (2011) where his doctoral dissertation focused on computational light modulation for image acquisition and display. In his talk, Wetzstein explores the frontiers of VR systems engineering. Eventually, VR/AR systems will redefine communication, entertainment, education, collaborative work, simulation, training, telesurgery, and basic vision research, as next-generation computational near-eye displays evolve to deliver visual experiences that are better than the real world.

3:00 – 3:30 pm Coffee Break

SPECIAL SESSION AND PANEL: Visually Lossless Video Quality for Modern Devices: Research and Industry Perspectives
Panel Moderator: Kjell Brunnstrom, Acreo Swedish ICT AB (Sweden)
Panelists: Damon Chandler, Shizuoka University (Japan); Phil Corriveau, Intel Corporation (United States); Scott Daly, Dolby Laboratories (United States); Edward Delp, Purdue University (United States); and James Goel, Qualcomm Inc. (Canada)
3:30 – 4:20 pm
Regency Ballroom B

3:30
Image and video compression for mobile: Is my screen small enough? (Invited), *Edward Delp, Purdue University (United States)* [HVEI-126]

3:40
Business perspectives on perceptually lossless and lossy quality (Invited), *Scott Daly, Dolby Laboratories (United States)* [HVEI-127]

3:50
Usage perspectives on perceptually lossless and lossy quality and assessment (Invited), *Philip Corriveau[1], Juliana Knopf[1], Hannah Colett[1], and Shun-nan Yang[2]; [1]Intel Corporation and [2]Pacific University (United States)* [HVEI-128]

4:00
Subjective assessment and the criteria for visually lossless compression (Invited), *Laurie Wilcox[1], Robert Allison[1], and James Goel[2]; [1]York University and [2]Qualcomm Inc. (Canada)* [HVEI-129]

4:10
Masked detection of compression artifacts on laboratory, consumer, and mobile displays (Invited), *Yi Zhang, Yusizwan Yaacob, and Damon Chandler, Shizuoka University (Japan)* [HVEI-130]

Moderated Discussion: Visually Lossless Video Quality for Modern Devices: Research and Industry Perspectives
Panel Moderator: Kjell Brunnstrom, Acreo Swedish ICT AB (Sweden)
Panelists: Damon Chandler, Shizuoka University (Japan); Phil Corriveau, Intel Corporation (United States); Scott Daly, Dolby Laboratories (United States); Edward Delp, Purdue University (United States); and James Goel, Qualcomm Inc. (Canada)
4:20 – 5:20 pm
Regency Ballroom B

The issues raised during this panel discussion, and a review of the resulting discussion, will be summarized in a proceedings manuscript, authored by all the contributing panelists:

4:20 118
Industry and business perspectives on the distinctions between visually lossless and lossy video quality: Mobile and large format displays (Invited), *Kjell Brunnstrom[1,2](Editor), L Robert Allison[6], Damon Chandler[4], Phil Corriveau[5], Scott Daly[3], Edward Delp[8], James Goel[7], Laurie Wilcox[6], Yusizwan Yaacob[4], Shun-nan Yang[9], and Yi Zhang[4]; [1]Acreo Swedish ICT AB (Sweden), [2]Mid Sweden University (Sweden), [3]Dolby Laboratories (United States), [4]Shizuoka University (Japan), [5]Intel Corporation (United States), [6]York University (Canada), [7]Qualcomm (Canada), [8]Purdue University (United States), and [9]Pacific University (United States)* [HVEI-131]

DISCUSSION: Perceptual, Cognitive, and Affective Issues in Image Representation, Compression, and Measurement

5:20 – 6:00 pm
Regency Ballroom B

In this session, authors from the day's papers will gather to participate in a dynamic discussion with the audience, moderated by the conference and session chairs. Since the papers and the participants represent diverse disciplines, interactive session promised to be exciting and provocative.

Symposium Demonstration Session
5:30 – 7:30 pm
Grand Peninsula Ballroom E

Wednesday, February 1, 2017

Computational Models of Human Color, Stereo, and High Dynamic Range

8:50 – 10:10 am
Regency Ballroom B

8:50 134
Orientation-ocularity maps: A technique for computer vision, *Alfredo Restrepo Palacios, Signa ex Lumine (Colombia)* [HVEI-132]

9:10 140
Evaluation of color prediction methods in terms of least dissimilar asymmetric matching, *Emitis Roshan and Brian Funt, Simon Fraser University (Canada)* [HVEI-133]

9:30 145
Characterization of spatiotemporal fluctuation in absorbed light energy by an array of interleaved photosensitive elements, *Shahram Peyvandi[1], Vebjorn Ekroll[2], and Alan Gilchrist[1]; [1]Rutgers, The State University of New Jersey (United States) and [2]University of Leuven (KU Leuven) (Belgium)* [HVEI-134]

9:50 151
Robust dynamic range computation for high dynamic range content, *Vedad Hulusic[1], Giuseppe Valenzise[2], Kurt Debattista[3], and Frederic Dufaux[2]; [1]Télécom ParisTech, Université Paris-Saclay (France), [2]CNRS - CentraleSupélec - Université Paris-Sud Gif-sur-Yvette (France), and [3]University of Warwick (United Kingdom)* [HVEI-135]

10:00 am – 4:00 pm Industry Exhibition
10:10 – 10:30 am Coffee Break

Special Session: Computational Modeling Inspired by Human Vision
Session Chair: Christopher Tyler, Smith-Kettlewell Eye Research Institute (United States)
10:30 am – 12:30 pm
Regency Ballroom B

10:30 156
GPU-accelerated vision modeling with the HPE cognitive computing toolkit (Invited), *Benjamin Chandler, Independent (United States)* [HVEI-136]

11:00 160
A neurally-inspired algorithm for detecting ordinal depth from motion signals in video streams (Invited), *Gennady Livitz, Harald Ruda, and Ennio Mingolla, Northeastern University (United States)* [HVEI-137]

11:30 167
Computational estimation of scene structure through texture gradient cues (Invited), *Christopher Tyler and Ajay Gopi; Smith-Kettlewell Eye Research Institute (United States)* [HVEI-138]

12:00
Learning visual representations for active perception (Invited), *Bruno Olshausen, Brian Cheung, and Eric Weiss, University of California, Berkeley (United States)* [HVEI-139]

12:30 – 2:00 pm Lunch Break

EI 2017 Wednesday Plenary and Symposium Awards
Session Chairs: Joyce E. Farrell, Stanford University, and Nitin Sampat, Rochester Institute of Technology (United States)
2:00 – 3:00 pm
Grand Peninsula Ballroom D

Designing VR video camera systems, *Brian Cabral, Facebook, Inc. (United States)*

Brian Cabral is Director of Engineering at Facebook, leading the Surround 360 VR camera team, specializing in computational photography, computer vision, and computer graphics. He has published a number of papers in the area of computer graphics and imaging including the pioneering Line Integral Convolution algorithm. Cabral discusses developing Facebook Surround 360, an open, high-quality 3D-360 video capture system. VR video capture systems are composed of multiple optical and digital components - all of which must operate as if they are one seamless optical system. The design of VR video cameras, optical choices, SNR, etc., require a new set of technologies and engineering approaches, with tight coupling to the computational system components.

3:00 – 3:30 pm Coffee Break

Image Statistics and Perceptual Features

Session Chairs: Bernice Rogowitz, Visual Perspectives (United States), and Huib de Ridder, Delft University of Technology (the Netherlands)

3:30 – 4:50 pm
Regency Ballroom B

3:30 177
Simulating retinal encoding: Factors influencing Vernier acuity, *Haomiao Jiang[1], Nicolas Cottaris[2], James Golden[1], David Brainard[2], Joyce Farrell[1], and Brian Wandell[1]; [1]Stanford University and [2]University of Pennsylvania (United States)* [HVEI-140]

3:50 182
Can 'crispening' be explained by contrast gain?, *David Kane and Marcelo Bertalmio, Universitat Pompeu Fabra (Spain)* [HVEI-141]

4:10 188
Defining self-similarity of images using features learned by convolutional neural networks, *Anselm Brachmann and Christoph Redies, Jena University Hospital (Germany)* [HVEI-142]

4:30 195
Determining the influence of image-based cues on human skin gloss perception, *Jing Wang[1], Thrasyvoulos Pappas[1], Jim Mayne[2], Carla Kuesten[2], and Gopa Majmudar[2]; [1]Northwestern University and [2]Amway Corporation (United States)* [HVEI-143]

Digital Humanities: Humans and/vs. Machines

Session Chair: Thrasyvoulos Pappas, Northwestern University (United States)

4:50 – 5:10 pm
Regency Ballroom B

4:50 203
Writer identification in modern and historical documents via binary pixel patterns, Kolmogorov-Smirnov test and Fisher's method (JIST-first), *Arie Shaus and Eli Turkel, Tel Aviv University (Israel)* [HVEI-144]

DISCUSSION: Computational Modeling, Perceptual Features, and Digital Humanities

5:10 – 6:20 pm
Regency Ballroom B

In this session, authors from the day's papers will gather to participate in a dynamic discussion with the audience, moderated by the conference and session chairs. Since the papers and the participants represent diverse disciplines, interactive session promised to be exciting and provocative.

Symposium Interactive Papers (Poster) Session
5:30 – 7:00 pm
Atrium

Thursday, February 2, 2017

Measuring Fatigue and Discomfort

Session Chair: Huib de Ridder, Delft University of Technology (the Netherlands)

8:50 – 9:30 am
Regency Ballroom B

8:50 212
Comparison of visual discomfort and visual fatigue between head-mounted display and smartphone, *Jungmin Han[1], Seon Hee Bae[2], and Hyeon-Jeong Suk[1]; [1]Korea Advanced Institute of Science and Technology and [2]Hansol Eye Clinic (Republic of Korea)* [HVEI-146]

9:10 218
Measuring visually induced motion sickness using wearable devices, *Ran Liu[1,2], Eli Peli[1], and Alex Hwang[1]; [1]Harvard University (United States) and [2]Chongqing University (China)* [HVEI-147]

Attention, Individual Differences, and Emotion

Session Chair: Bernice Rogowitz, Visual Perspectives (United States)

9:30 – 10:30 am
Regency Ballroom B

9:30 224
Developmental changes in ambient and focal visual processing strategies, *Onkar Krishna[1], Toshihiko Yamasaki[1], Andrea Helo[2], Pia Rämä[2], and Kiyoharu Aizawa[1]; [1]The University of Tokyo (Japan) and [2]Université Paris Descartes (France)* [HVEI-148]

9:50 230
Gaze-contingent center-surround fusion of infrared images to facilitate visual search for human targets (JIST-first), *Mackenzie Glaholt and Grace Sim, Defence Research and Development Canada (Canada)* [HVEI-149]

10:10 236
Evaluation and prediction of evoked emotions induced by image manipulations, *Lin Yuan and Touradj Ebrahimi, EPFL (Switzerland)* [HVEI-150]

10:30 – 11:00 am Coffee Break

Special Session: Art and Aesthetics, Part I: Measuring Artistic and Aesthetic Judgments
Session Chairs: Claus-Christian Carbon, University of Bamberg (Germany), Elena Fedorovskaya, Rochester Institute of Technology (United States), and Monica Lopez-Gonzalez, La Petite Noiseuse Productions (United States)
11:00 am – 12:30 pm
Regency Ballroom B

11:00 242
Measurement problems and measurement strategies for capturing the rich experience of art (Invited), *Claus-Christian Carbon[1,2], [1]University of Bamberg and [2]EPAEG (Germany)* [HVEI-151]

11:30 248
The gist of beauty: An investigation of aesthetic perception in rapidly presented images (Invited), *Caitlin Mullin[1], Gregor Hayn-Leichsenring[2], Christoph Redies[2], and Johan Wagemans[3]; [1]Massachusetts Institute of Technology (United States), [2]University of Jena (Germany), and [3]University of Leuven (Belgium)* [HVEI-152]

12:00 257
Gaze patterns in art viewing and their dependency on expertise and image characteristics (Invited), *Elena Fedorovskaya, Sanjana Kapisthalam, and Yingtong Bu, Rochester Institute of Technology (United States)* [HVEI-153]

12:30 – 2:00 pm Lunch Break

Special Session: Art and Aesthetics, Part II: Producing Art from the Artists' and Scientists' Perspectives
Session Chairs: Claus-Christian Carbon, University of Bamberg (Germany), Elena Fedorovskaya, Rochester Institute of Technology (United States), and Monica Lopez-Gonzalez, La Petite Noiseuse Productions (United States)
2:00 – 3:30 pm
Regency Ballroom B

2:00 261
Imaging human vision: An artistic perspective (Invited), *Robert Pepperell, Cardiff Metropolitan University (United Kingdom)* [HVEI-154]

2:30 268
Addressing long-standing controversies in conceptual knowledge representation in the temporal pole: A cross-modal paradigm (Invited), *Lora Likova, Smith-Kettlewell Eye Research Instituite (United States)* [HVEI-155]

3:00 273
Trading conversations between science and art: When musical improvisation enters the dialogue on stage (Invited), *Mónica López-González, La Petite Noiseuse Productions (United States)* [HVEI-156]

3:20 – 4:00 pm Coffee Break

DISCUSSION: Embracing the Complexity of Human Experience

3:30 – 4:30 pm
Regency Ballroom B

In this session, authors from the day's papers will gather to participate in a dynamic discussion with the audience, moderated by the conference and session chairs. Since the papers and the participants represent diverse disciplines, interactive session promised to be exciting and provocative.

Museum Visit: San Francisco Museum of Modern Art

5:30 – 7:30 pm
Offsite

The San Francisco Museum of Modern Art is open again, after a significant multi-year renovation. To celebrate, we will be organizing a Museum Visit and informal dinner party for Friends of HVEI. Members of the HVEI community will provide perceptual and cognitive insights into pieces in the Museum Collection. Everyone is responsible for his or her own transportation, museum entrance fees and dinner. Anyone interested can meet in the Hotel Lobby at 5:00 to arrange shared cab rides or Ubers. The tour begins at 5:30 at the ticket booth in the museum lobby.

Friends of HVEI Casual Dinner

7:30 – 9:30 pm
Offsite

This casual dinner follows immediately after the museum visit.