Computer Arts Laboratory

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Most of the courses taken by engineers and computer science students emphasize scientific discipline and accumulation of "truth." The Computer Arts Lab. activities include such technically objective factors, but also encourage original expression, subjectively motivated by æsthetics rather than "correctness," sometimes "putting the art before the course!" Unlike many other labs' activities that try to converge on a "right answer" sharable by everyone else, artistic disciplines encourage originality, in which the best answer is one that is like no one else's.

The Computer Arts Lab., through its resident Spatial Media Group,[1] is researching projects including practical and creative applications of virtual reality and mixed (augmented, enhanced, hybrid, mediated) reality and virtuality; panoramic interfaces and spatially-immersive displays (especially stereotelephonics, spatial sound, and stereography); wearable and mobile applications, computing, and interfaces; and networked multimedia, with related interests in CVEs (**c**ollaborative **v**irtual **e**nvironments), groupware and CSCW (**c**omputer-**s**upported **c**ollaborative **w**ork); hypermedia; digital typography and electronic publishing; force-feedback displays; telecommunication semiotics (models of teleconferencing selection functions); information furniture; way-finding and navigation (including using a Segway personal transporter); entertainment computing; ubicomp (ubiquitous computing), calm (ambient), and pervasive technology. We are particularly interested in narrowcasting commands, conference selection functions for adjusting groupware situations in which users have multiple presence, virtually existing in more

[1] `http://www.u-aizu.ac.jp/~mcohen/spatial-media/welcome.html`

than one space simultaneously. We investigate realtime interactive multimedia interfaces— auditory, visual, haptic, and multimodal:

Auditory We are exploring interfaces for multichannel sound, including stereo, quadraphonic, and nearphones (mounted on our Schaire rotary motion platform), as well as speaker array systems in the **U**niversity-**B**usiness **I**nnovation **C**enter 3D Theater.[2] Lab faculty members Julián Villegas[3] and Michael Cohen[4] teach the "Intro. to Sound and Audio" graduate school course,[5], featuring extensive experiential learning featuring applications such as Audacity[6] and Pure Data.[7] That course is a prerequisite for "Spatial Hearing and Virtual 3D Sound,"[8] taught jointly with Prof. Jie Huang; 黄 捷 in the Human Interface Lab.

We host a Computer Music Studio, featuring keyboard synthesizers and computer music workstations complemented by assorted amplifiers, racks, mixers, and effects processors.

We annually conduct a **S**tudent **C**ooperative **C**lass **P**roject.[9] In the past we sponsored SCCPs on Digital Compositing (using Photoshop and the Gimp[10]), but in recent years the SCCP has been focused on Computer Music,[11] studying basic music theory and DTM (**d**esk-**t**op **m**usic) software, including samplers and MIDI sequencers[12] to compose and perform student-authored songs. This SCCP segues into a graduate level computer music course.[13]

Visual We promote creative applications of scientific visualization, encouraging the use of Mathematica[14] and stereoscopy,[15] including chromas-

[2] http://www.ubic-u-aizu.jp/shisetsu/kengaku.html
[3] http://www.u-aizu.ac.jp/~julian
[4] http://www.u-aizu.ac.jp/~mcohen
[5] http://www.u-aizu.ac.jp/~mcohen/welcome/courses/AizuDai/graduate/Sound+Audio/syllabus.html
[6] http://audacity.sourceforge.net
[7] http://puredata.info
[8] http://web-int/~j-huang/Lecture/3DSound/3dsound.html
[9] http://www.u-aizu.ac.jp/official/curriculum/syllabus/2014_3_E_001.html#E814005
[10] http://www.gimp.org
[11] http://www.u-aizu.ac.jp/~mcohen/welcome/courses/AizuDai/undergraduate/Computer_Music
[12] http://www.apple.com/ilife/garageband, http://www.pgmusic.com/band.htm
[13] http://www.u-aizu.ac.jp/~mcohen/welcome/courses/AizuDai/graduate/Computer_Music/syllabus.html
[14] http://www.u-aizu.ac.jp/~mcohen/welcome/courses/AizuDai/Mma.html
[15] http://www.u-aizu.ac.jp/~mcohen/spatial-media/stereograms.html

tereoscopy[16] (3D images with depth layers cued by color). We enjoy exploiting the unique large-format immersive stereographic display in the UBIC 3D Theater. The "M-Project" student CAD and CG circle[17] is hosted in our lab, under the supervision of Profs. Satoshi Nishimura; 西村 憲 and Michael Cohen. We are experimenting with various CAD authoring tools, such as 3DStudioMax, Blender, Maya, and Sketch-Up, as well as Illustrator and PhotoShop. We are also exploring creative applications of panoramic imaging and object movies, including a virtual tour of the university.[18]

Haptic We are also exploring the use of haptic interfaces, including force-display joysticks and a rotary motion platform (the Schaire" [for 'shared chair'] Internet Chair"). A recent project deployed the Sudden Motion Sensor in a laptop for gyroscopic control of avatars in a virtual environment.[19] We also convene annual **C**reative **F**actory **S**eminars.[20] Past CFSs explored advanced audio interfaces and panoramic imaging, but in recent years, in conjunction with Prof. Rentaro Yoshioka; 吉岡 廉太郎 [21] of the Active Knowledge Engineering Lab., we conduct a workshop on Haptic Modeling and 3D Printing,[22] using force-feedback CAD workstations[23] to make models that are then rapid prototyped (as stereolithograms) with our personal fabricator, closing the "idea (stored in brain neurons) – information (stored as bits) – matter (atoms)" pathway.

Multimodal Using such multimodal interfaces, our students have crafted driving simulators, location-based games featuring the rotary motion platform,[24] and synæsthetic (cross-sensory modality) visual and haptic

[16] http://www.chromatek.com
[17] http://mpro-aizu.blogspot.com
[18] http://www.u-aizu.ac.jp/~mcohen/welcome/courses/AizuDai/undergraduate/HI&VR/VirtualTour/
[19] http://www.u-aizu.ac.jp/~mcohen/welcome/publications/SMS-CVE.mov
[20] http://www.u-aizu.ac.jp/official/curriculum/syllabusCFS/curr04-cfs_e.html
[21] http://www.u-aizu.ac.jp/~rentaro
[22] http://www.u-aizu.ac.jp/official/curriculum/syllabus/2013_2_E_004_000.html#MC05
[23] http://http://geomagic.com/en/products-landing-pages/sensable
[24] http://sonic.u-aizu.ac.jp/spatial-media/mixedreality/VideoClips/KuruKuru-pitcher-long.mov

music players (rendering songs as light shows[25] or dancing chairs[26]). Using visual sensing techniques, narrowcasting postures can be recognized, and used to control distributed chatspaces or virtual concerts. A student project deployed a microphone vector to track a moving sound source, using its network interface to trigger internet appliances (like lights that follow the source). We are also developing a driving simulator using collision-detection modulation of the force-feedback steering wheel and the rotary motion platform. A recent version of the project features a dual-steering (front and back) fire truck, racing through a 3D model of our campus to reach a fire, piloted by two drivers, and featuring spatial sound effects. We are interested in exploring using figurative interfaces to express emotion and to control narrowcasting privacy using a media mixing system based on the **S**ession **I**nitiation **P**rotocol for advanced conferencing features. We are also exploring extensions of Open Wonderland,[27] an open-source framework for developing virtual reality environments. Group members developed windshield wipers that dance, featuring beat detection, a digital phase-locked loop, and articulated wiper gestures.[28]

We are also exploring mobile (nomadic, portable) computing, working in conjunction with university spin-offs Aizu Lab,[29] The Designium,[30] Eyes, JAPAN,[31] and GClue.[32] Such *keitai*-based interfaces can be used to design kaleidoscopic "wallpaper" screen savers, or to control internet appliances, panoramic imaging, spatial sound, or motion platforms. In the past we combined spatial sound with way-finding, using GPS tracking, our Segway personal transporter,[33] and directional transfer functions.

A advanced undergraduate course on "Human Interface and Virtual Reality"[34] surveys many of these topics, contextualized by "machinema"

[25] http://sonic.u-aizu.ac.jp/spatial-media/mixedreality/VideoClips/CITMixedReality_Demo.wmv

[26] http://sonic.u-aizu.ac.jp/spatial-media/mixedreality/VideoClips/keitai+Schaire2.mov

[27] http://openwonderland.org

[28] http://www.u-aizu.ac.jp/~mcohen/spatial-media/VMPMyRide

[29] www.aizulab.com

[30] http://www.thedesignium.com

[31] http://www.aizu.com

[32] http://www.gclue.com

[33] http://www.segway.com

[34] http://web-int.u-aizu.ac.jp/~mcohen/welcome/courses/AizuDai/undergraduate/

(machine cinema) using "Alice,"[35] featuring student-designed and -programmed, computer-generated interactive stories with 3D animation—including texture maps, photographic compositing, audio effects, speech synthesis, background music— and segments on panoramic and turnoramic imagery, stereopsis, and groupware.

Other activities:

We host an annual symposium, the Int. Symposium on Spatial Media,[36] inviting experts to share their knowledge and passion regarding such themes as "Spatial Sound and Spatial Telepresence" ('00–'01), "Magic in Math and Music" ('01–'02), "Advanced Multimedia and Virtual Reality" ('02–'03), "Spatial Sound" ('03–'04), "Hearing and Sound Installations" ('04–'05), "Sound, Audio, and Music" ('05–'06), "Interactive Media, Security, and Stereography" ('06–'07), "Internet Media" ('07–'08), "Computation and Music" ('08–'09), "Systems and Applications" ('09–'10) "Distributed, Mobile, and Ubiquitous Multimodal Interfaces" ('10–'11), "Social Multimedia" ('11–'12), "Visual Interfaces for Multimedia Systems" ('12–'13), and "Multimodal Signs: Computer Enhancement of User Experience" ('13–'14). This past year our meeting was held in conjunction with the 16th International Conference on Humans and Computers (HC-2013)[37]

HI&VR

[35] http://www.alice.org

[36] http://www.u-aizu.ac.jp/~mcohen/welcome/ISSM/13-14/

Refereed Journal Papers

[mcohen-01:2013] Michael Cohen, Yannis Haralambous, and Boris Veytsman. The Multibibliography Package. *TUGboat: Communications of the TEX Users Group*, 34(3):901–904, 2013.

Conventional standards for bibliography styles entail a forced choice between index and name/year citations and corresponding references. We reject this false dichotomy, and describe a multibibliography, comprising alphabetic, sequenced, and also chronological orderings of references. An extended inline citation format is also presented which integrates such heterogeneous styles, and is usable and useful even without separate bibliographies. Richly hyperlinked for electronic browsing, the citations are articulated to select particular bibliographies, and the bibliographics are cross-referenced through their labels, linking among them. `https://tug.org/TUGboat/Contents/contents34-3.html`, `http://www.ctan.org/pkg/multibibliography`

[mcohen-02:2013] Michael Cohen, Rasika Ranaweera, Hayato Ito, Shun Endo, Sascha Holesch, and Julián Villegas. "Twin Spin": Steering Karaoke (or anything else) with Smartphone Wands Deployable as Spinnable Affordances. *MC²R: SIGMOBILE Mobile Computing and Communications Review*, 16(4):4–5, feb 2013.

We have built haptic interfaces featuring smartphones and tablets that use magnetometer-derived orientation sensing to modulate virtual displays, especially spatial sound, allowing, for instance, each side of a karaoke recording to be separately steered around a periphonic display. Embedding such devices into a spinnable affordance allows a "spinning plate"-style interface, a novel interaction technique. Either static (pointing) or dynamic (spinning) modes can be used to control "whirled" multimodal display, including a rotary motion platform, panoramic movies, and the positions of avatars in virtual environments. `www.sigmobile.org/pubs/mc2r`, `http://doi.acm.org/10.1145/2436196.2436199`

[mcohen-03:2013] Senaka Amarakeerthi, Chamin Morikawa, Tin Lay Nwe, Liyanage C. De Silva, and Michael Cohen. Cascaded Subband Energy-Based Emotion Classification. *IEEJ Trans. on Electronics, Information and Systems*, 133(1):200–210, jan 2013.

Since the earliest studies of human behavior, emotions have attracted attention of researchers in many disciplines, including psychology, neuroscience, and lately computer science. Speech is considered a salient

conveyor of emotional cues, and can be used as an important source for emotional studies. Speech is modulated for different emotions by varying frequency- and energy-related acoustic parameters such as pitch, energy, and formants. In this paper, we explore analyzing inter- and intra-subband energy variations to differentiate six emotions. The emotions considered are anger, disgust, fear, happiness, neutral, and sadness. In this research, Two-Layered Cascaded Subband Cepstral Coefficients (TLCS-CC) analysis was introduced to study energy variations within low and high arousal emotions as a novel approach for emotion classification. The new approach was compared with Mel frequency cepstral coefficients (MFCC) and log frequency power coefficients (LFPC). Experiments were conducted on the Berlin Emotional Data Corpus (BECD). With energy-related features, we could achieve average accuracy of 73.9% and 80.1% for speaker-independent and -dependent emotion classification respectively. `https://www.jstage.jst.go.jp/article/ieejeiss/133/1/133_200/_article`, DOI: 10.1541/ieejeiss.133.1

Unrefereed Papers

[mcohen-04:2013] Michael Cohen. Multimodal Machinema at the University of Aizu. *AIS SIGHCI Newsletter (Assoc. for Information Systems, Special Interest Group on Human-Computer Interaction)*, 12(1):10–11, July 2013.

In the Human Interface and Virtual Reality course taken by computer science students at the University of Aizu in Aizu-Wakamatsu, Japan, creativity is emphasized over conformity. Unlike most other courses that try to converge on a shared "right answer," artistic disciplines encourage originality, in which the best answer is identical to no one else's. The course includes technically objective matters, but explicitly encourages original expression, subjectively motivated by aesthetics rather than "correctness." Most of the coursework involves lab exercises emphasizing creative applications of digital contents creation tools, highlighting design and invention as much as discovery. The power of experiential education is leveraged by lessons with an emphasis on practical experimentation, learning by doing.

Refereed Proceeding Papers

[julian-01:2013] Jorge Gonzalez Alonso and Julián Villegas. Dominance takes precedence: L3 English processing by Basque-Spanish bilinguals. In *AESLA, 31 Int. Conf. on Communication, Cognition and Cybernetics*, page NA, 2013.

Word-formation processes vary greatly among languages, although those which are typologically close tend to cluster around particular configurations which may or may not differ from those of other linguistic families. Compound words in Romance and Germanic languages have been considered by both theoretical linguistsand acquisitionists, with the latter focusing more on the interplay between two or more systems in a multilingual setting. The case of deverbal N+N compounds (e.g. can opener) in English as compared to their [V+N]N Spanish semantic equivalents (e.g. abrelatas 'can opener', lit. 'opens-cans') is particularly interesting. What seems apparent is that Spanish and English do not lexicalise verb-noun relationships in the same way. Basque, in contrast, does seem to have direct parallels with English: Basque deverbal compounds are also right-headed N+N constructions, in which the deverbal head has been nominalised through affixation (e.g. lata irekigailu, lit. 'can opener'). Considering these facts, are there any facilitatory effects in processing for those bilinguals whose L1 is similar to the L3 (English) in the formation of deverbal compounds? An experiment was carried out in which we controlled for both language profile and proficiency. We predicted practically equal accuracy rates for all groups at comparable levels of proficiency, since the effect is not expected to override lexical knowledge; a faster performance of the monolingual group, due to an attested higher processing cost in bilinguals (Ivanova & Costa, 2008); and shorter response latencies for the Basque-dominant bilinguals as opposed to their Spanish-dominant counterparts, since the critical structure is hypothesised to be more readily available for the former group. Response latencies and accuracy rates were analysed with two independent two-way ANOVA with proficiency in English and language profile as factors. Results have largely matched our predictions.

[julian-02:2013] Tetunobu Ohashi, Julián Villegas, and Michael Cohen. Controlling tempo in real-time with mobile devices. In *Proc. Tohoku Section Joint Conv. of Institutes of Electrical and Information Engineers*, page 85, Aug 2013.

In this research we explored the ability of controlling the reproduction speed of a digitized melody by means of portable devices such as smartphones.

[julian-03:2013] Yuya Sasamoto, Michael Cohen, and Julián Villegas. Controlling spatial sound with table-top interface. In *Proc. Int. Joint Conf. on Awareness Science and Technology & Ubi-Media Computing*, pages 713–718, Nov 2013.

Interactive table-top interfaces are multimedia devices which allow sharing information visually and aurally among several users. Table-top interfaces for spatial sound environments are frequently investigated in the field of the human interfaces. Table-top interfaces are utilized as groupware and it is suitable for collaborative work, and it is convenient for a group working on theme related to sound systems. A representative of table-top musical instrument is the reacTable. In this paper, we present a way to control the position of multiple sounds in a spatial sound environment via a table-top interface. Sound localization is required to discriminate and recognize clearly sounds. We have been investigating musical table-top instruments which are capable of controlling multiple sound in spatial sound environments. One of the main features of this new developed system is that multiple users can control the spatialization of independently sounds in real-time. We verified changes of user recognition to multi-sound with a spatial sound environment.

[julian-04:2013] Julián Villegas and Michael Cohen. Real-time head-related impulse response filtering with distance control. In *Proc. 135 Audio Eng. Soc. Conv.*, page NA, New York, USA, Oct 2013.

We present a new software application based on a recently collected hrir database comprising measurements at different distances. The new application, programmed in Pure-data, is capable of directionalizing sound objects at any azimuth, at elevations between -40 and 90, and at distances $20-160$ cm. This truly 3D spatialization is done by pre-calculating the minimum-phase version of the hrirs and computing the interpolation of a maximum of four hrir measurements, depending upon the virtual location. In the same way, interaural time differences are computed and applied to the convolved signal. For demanding real-time constraints, the number of taps used for the convolution can be adjusted, up to a maximum of 1024.

[julian-05:2013] Ian Wilson, Julián Villegas, and Terumasa Doi. Lateral tongue bracing in Japanese and English. In *Proc. of Ultrafest VI: the sixth Ultrafest meeting of researchers working with Ultrasound imaging technology for linguistic analysis*, page NA, Nov 2013.

Coronal ultrasound imaging was used to compare the degree of lateral tongue bracing that occurs in English with that occurring in Japanese. The speech of Japanese speakers of English as a second language was examined to test the hypothesis that those who brace more (as is thought to be normal for English native speakers) have pronunciation that is perceived to be closer to native-like.

[julian-06:2013] Michael Cohen, Rasika Ranaweera, Kensuke Nishimura, Yuya Sasamoto, Tomohiro Oyama, Tetsunobu Ohashi, Anzu Nakada, Julián Villegas, Yong Ping Chen, Sascha Holesch, Jun Yamadera, Hayato Ito, Yasuhiko Saito, and Akira Sasaki. Twirled affordances, self-conscious avatars, & inspection gestures. In *Proc. SIGGRAPH Asia: Symposium on Mobile Graphics and Interactive Applications*, pages 95:1–95:1, Nov 2013.

Contemporary smartphones and tablets have magnetometers that can be used to detect yaw, which data can be distributed to adjust ambient media. We have built haptic interfaces featuring smartphones and tablets that use compass-derived orientation sensing to modulate virtual displays. Embedding mobile devices into pointing, swinging, and flailing affordances allows "padiddle"-style interfaces, finger spinning, and "poi"-style interfaces, whirling tethered devices, for novel interaction techniques.

[julian-07:2013] Jorge Gonzalez Alonso, Maria del Pilar Garcia Mayo, and Julián Villegas. L3 morpho-lexical processing: Effects of bilinguals' language dominance. In *Proc. GASLA 12: The 12th Int. Conf. on Generative Approaches to Second Language Acquisition*, page NA, Florida, Apr. 2013.

We studied the effects of bilinguals' language dominance in word-formation processes. Especifically, we analized the case of noun-compounds in terms of accuracy and response time for two trilingual groups: Spanish-Euskera-English, and Euskera-Spanish-English (in order of dominance). Results have largely matched our predictions: no significant effect of the participants' linguistic profile was found

on their accuracy rates (F(2) = 0.098, p = .906), a factor which was however significantly influential on their response latencies to the critical conditions (F(2) = 31.334, p ¡ .001).

[julian-08:2013] Michael Cohen, Rasika Ranaweera, Kensuke Nishimura, Yuya Sasamoto, Shun Endo, Tomohiro Oyama, Tetunobu Ohashi, Yukihiro Nishikawa, Ryo Kanno, Anzu Nakada, Julián Villegas, Yong Ping Chen, Sascha Holesch, Jun Yamadera, Hayato Ito, Yasuhiko Saito, and Akira Sasaki. "Tworlds": Twirled Worlds for Multimodal 'Padiddle' Spinning & Tethered 'Poi' Whirling. In *Proc. of SIGGRAPH*, pages 67:1–67:1, Nov 2013.

Modern smartphones and tablets have magnetometers that can be used to detect yaw, which data can be distributed to adjust ambient media. Either static (pointing) or dynamic (twirling) modes can be used to modulate multimodal displays, including 360° imagery and virtual environments. Azimuthal tracking especially allows control of horizontal planar displays, including panoramic and turnoramic imaged-based rendering, spatial sound, and the position of avatars, virtual cameras, and other objects in virtual environments such as Alice, as well as rhythmic renderings such as musical sequencing.

[julian-09:2013] Julián Villegas, William L. Martens, Michael Cohen, and Ian Wilson. Spatial separation decreases psychoacoustic roughness of high-frequency tones. In *J. Acoust. Soc. Am.*, volume 134, page 4228, Dec 2013.

Perceived roughness reports were collected for pairings of sinusoidal tones presented either over loudspeakers or headphones such that the sounds were collocated or spatially separated 90 degrees in front of the listener (+ /- 45 degrees). In the loudspeaker experiment, pairs of sinusoids were centered at 0.3, 1.0, and 3.3 kHz, and separated by half a critical band. In the headphone experiment, the pairs of sinusoids were centered at 0.5, 1.0, and 2.0 kHz, and separated by a semitone. Although not all listeners' reports showed the influence of spatial separation as clearly as others, analysis indicates that listeners generally found spatially separated tone combinations less rough when the frequencies of those tones were centered at 2.0 kHz or higher. This trend was also observed in a follow-up study with 20-component complex tones at fundamental frequencies of C2, C3, A4, and C4 (131, 262, 440, and 523 Hz, respectively) pre-

sented via headphones. These results suggest that spatial separation decreases perceived roughness, especially for tones with frequencies higher than the threshold at which interaural time differences rival interaural level differences for sound localization (approximately 2.3 kHz) and that the current roughness models need to be reviewed to include binaural effects.

[julian-10:2013] Bektur Ryskeldiev, Julián Villegas, and Michael Cohen. Exploring virtual sound environments with mobile devices. In *Proc. of Tohoku Section Joint Conv. of Institutes of Electrical and Information Engineers*, page 18, Aug 2013.

The aim of this research is to explore virtual sound environments with mobile devices, using iOS as a main platform and Pure Data (Pd) as a backend for sound processing. The underlying calculations are based on human ' s natural and linear interpolation between virtual sound sources. As a result, the developed application allows user to " walk around " virtual concerts, as well as to experiment with positions of sound sources by moving them GUI manually.

[julian-11:2013] Shogo Saze, Julián Villegas, and Michael Cohen. Map- and photo-enabled navigation assistance in a driver simulator. In *Proc. of Tohoku Section Joint Conv. of Institutes of Electrical and Information Engineers*, page 279, Aug 2013.

In this research we exp.ored the feasability of using driving simulators for a more intuitive navigation through maps and Google street view.

[mcohen-05:2013] Yuya Sasamoto, Michael Cohen, and Julián Villegas. Controlling Spatial Sound with Table-top Interface. In *iCast & UMedia: Proc. Int. Joint Conf. on Awareness Science and Technology & Ubi-Media Computing*, pages 713–718, Aizu-Wakamatsu, nov 2013.

Interactive table-top interfaces are multimedia devices which allow sharing information visually and aurally among several users. Table-top interfaces are utilized as groupware and are suitable for collaborative work, convenient for a group working on themes related to sound systems. Table-top interfaces for spatial sound environments are starting to be investigated in the field of the human interfaces. A representative table-top musical instrument is the reacTable. In this paper, we present a way to control the position of

multiple virtual sounds in a spatial sound environment via such a table-top interface. Sound localization is required to discriminate and clearly recognize sounds. We have been investigating musical table-top instruments which are capable of controlling multiple input and output channels in spatial sound environments. One of the main features of this newly developed system is that multiple users can independently control the spatialization of sounds in real-time. http://www.u-aizu.ac.jp/conference/conf2013/umedia13, http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6765530

[mcohen-06:2013] Julián Villegas and Michael Cohen. Real-time head-related impulse response filtering with distance control. In *Audio Engineering Society 135th Conv.*, pages EB3–2, New York, oct 2013.

We present a new software application based on a recently collected hrir database comprising measurements at different distances. The new application, programmed in Pure-data, is capable of directionalizing sound objects at any azimuth, at elevations between −40 °C and 90 °C, and at distances 20-− 160 cm. This truly 3D spatialization is done by pre-calculating the minimum-phase version of the HRIRs and computing the interpolation of a maximum of four hrir measurements, depending upon the virtual location. In the same way, interaural time differences are computed and applied to the convolved signal. For demanding real-time constraints, the number of taps used for the convolution can be adjusted, up to a maximum of 1024.

[mcohen-07:2013] Shogo Saze, Julián Villegas, and Michael Cohen. Map- and Photo-Enabled Navigation Assistance in a Driving Simulator. In *TSJC: Tohoku Section Joint Convention of Institutes of Electrical and Information Engineers, Japan*, page 279, Aizu-Wakamatsu, aug 2013.

This research is about building a driving simulator using panoramic imagery. Driving simulators are used for entertainment as well as in training of drivers. The purpose of this research is enabling driving simulators to get the feeling of being operated in reality by using actual imagery. http://www.ecei.tohoku.ac.jp/tsjc/

[mcohen-08:2013] Bektur Ryskeldiev, Julián Villegas, and Michael Cohen. Exploring Virtual Sound Environments with Mobile Devices.

In *TSJC: Tohoku Section Joint Convention Record of Institutes of Electrical and Information Engineers, Japan*, page 18, Aizu-Wakamatsu, aug 2013.

The aim of this research is to explore virtual sound environments with mobile devices, using iOS as a main platform and Pure Data (Pd) as a backend for sound processing. The underlying calculations are based on human ' s interaural time difference and distance between virtual sound sources. As a result, the developed application allows users to "walk" around virtual concert, as well as to experiment with positions of sound sources by moving them manually with a GUI. `http://www.ecei.tohoku.ac.jp/tsjc/`; Best Paper Prize, Student Section

[mcohen-09:2013] Tetunobu Ohashi, Julián Villegas, and Michael Cohen. Controlling Tempo in Real-time With Mobile Devices. In *TSJC: Tohoku Section Joint Convention Record of Institutes of Electrical and Information Engineers, Japan*, page 85, Aizu-Wakamatsu, aug 2013.

We describe an interface to control tempo in realtime while an audio file is playing. A Pure Data patch has been developed to play audio files and control the music tempo by receiving data taken from sensors of iOS devices. Such an interface is designed to enable performance of music by twirling mobile devices. Twirling speed controls musical rendition speed. This project is developed basically for entertainment, and make it possible to let people enjoy playing songs or music in their own styles. `http://www.ecei.tohoku.ac.jp/tsjc/`

[mcohen-10:2013] Anzu Nakada, Michael Cohen, and Rasika Ranaweera. Integrating the Collaborative Virtual Environment Protocol with Mathematica. In *Proc. HC: Int. Conf. on Human-Centered Computer Environments*, pages 778–784, Aizu-Wakamatsu, nov 2013.

We have built interfaces featuring smartphones and tablets that use magnetometer-derived orientation sensing to control spatial sound, motion platforms, panoramic and turnoramic image-based renderings, virtual displays, and other programs. To leverage our Collaborative Virtual Environment (CVE), which is implemented in pure Java, against the power of Mathematica, we use J/Link middleware. As a result, we can exploit Mathematica features of graph-

ics and calculation and control the Mathematica Kernel by data from, among other clients, mobile devices. http://ktm11.eng.shizuoka.ac.jp/conference.html#HC2013

[mcohen-11:2013] Prabath Weerasinghe, Chandrajith Ashuboda Marasinghe, Rasika Ranaweera, Senaka Amarakeerthi, and Michael Cohen. Emotion Expression for Affective Social Communication. In *Proc. ICBAKE: Int. Conf. on Biometrics and Kansei Engineering*, pages 148–153, jul 2013.

Human interaction with social networking service (SNS) is currently a very active research area. In recent years, micro-blogs and social networking sites have become an increasingly popular means of communication among the online community. Examples for such sites are Face book, Twitter, Google+, MySpace, Hi5, and WAYN. Micro-blog posts, such as tweets, allow users to broadcast their idea in short form of text, voice or images, using mobile devices and computers. Modern mobile devices–— such as feature phones, smartphones, tablets, & netbooks–— are internet-capable and feature various convenient hardware capabilities are building and managing social relationships between people. Text and speech enriched with emotions is one of the major ways of exchanging ideas, especially via telephony and SNS. By analyzing a voice stream using a Hidden Markov Model (HMM) and Log Frequency Cepstral Coefficients (LFPC) based system, different emotions can be recognized. Using a simple Java client, recognized emotions can be delivered to a sever as an index. A mobile client can then retrieve the emotion and display it through colored icons. Each emotion is mapped to a particular color, as it is natural to use colors to represent various expressions. We believe that with the help of this application one could conceivably change one ' s way of talking or avoid chatting with somebody whose emotional state is negative! By analysing a text snippet using C4.5 decision tree, Support Vector Machine (SVM), different emotions can be recognized. Not only for voice, these methods can be use when user composes text messages. http://www.sd.tmu.ac.jp/ICBAKE2013, http://doi.ieeecomputersociety.org/10.1109/ICBAKE.2013.31

[mcohen-12:2013] Rasika Ranaweera, Michael Cohen, and Michael Frishkopf. Narrowcasting Enabled Immersive Music Browser for Folkways World Music Collection. In Tolga Capin, Selim Bal-

cisoy, and Daniel Thalmann, editors, *CASA: Proc. Int. Conf. on Computer Animation and Social Agents*, page Paper #32, Istanbul, may 2013.

We have developed a novel application for listening to music in which avatar-represented users can find and listen to selections from the Smithsonian Folkways world music collection. The system is collaborative: multiple avatars can enter the space, audition track samples, and contribute their own sounds (typically speech) to the mix via voice chat. Avatars by default can hear within the space all sound sources (musical tracks and sounds produced by other avatars), attenuated for distance and mixed according to a spatial sound engine that emulates real-world binaural hearing. When cacophony from nearby tracks distracts, one's soundscape can be refined since the system supports narrowcasting, a technique which allows information streams to be filtered. `www.cs.bilkent.edu.tr/~casa2013`, ISBN 978-605-4348-53-4

[mcohen-13:2013] Michael Cohen. Multimedia Machinema at the University of Aizu. In *Proc. Alice Symposium*, page Article No. 10, Durham, North Carolina, jun 2013.

We introduce students to the basics of human interface technology and the virtual reality paradigm, especially through "desktop VR" (a.k.a. "fishtank VR"), a "hands-on" approach emphasizing creation of self-designed virtual worlds. The main vehicle of expression is "Alice," used to contextualize segments on color models, image capture and compositing, computer graphics, graphic composition and 3D drawing, IBR (image-based rendering) & texture mapping, sound, audio, & music, as well as software engineering. Segments on stereoscopy and 360° panoramic and turnoramic imagery and image-based rendering are also included. We use Photo Booth, iPhoto, SumoPaint, Audacity, and GarageBand as support tools for multimedia content creation. Students use self-designed multimodal interfaces authored with object-oriented techniques to tell stories with virtual characters and cinematography (camera motion and gestures, "camerabatics") for deterministic machinema and also dynamic environments such as games and digital stories. `http://dx.doi.org/10.1145/2532333.2532344`

[mcohen-14:2013] Julián Villegas, William L. Martens, Michael Cohen, and Ian Wilson. Spatial separation decreases psychoacoustic

roughness of high-frequency tones. In *ASA: 166th Mtg. of the Acoustical Society of America*, volume 134, page 4228, San Francisco, dec 2013.

Perceived roughness reports were collected for pairings of sinusoidal tones presented either over loudspeakers or headphones such that the sounds were collocated or spatially separated 90 degrees in front of the listener (+/- 45 degrees). In the loudspeaker experiment, pairs of sinusoids were centered at 0.3, 1.0, and 3.3 kHz, and separated by half a critical band. In the headphone experiment, the pairs of sinusoids were centered at 0.5, 1.0, and 2.0 kHz, and separated by a semitone. Although not all listeners ' reports showed the influence of spatial separation as clearly as others, analysis indicates that listeners generally found spatially separated tone combinations less rough when the frequencies of those tones were centered at 2.0 kHz or higher. This trend was also observed in a follow-up study with 20-component complex tones at fundamental frequencies of C2, C3, A4, and C4 (131, 262, 440, and 523 Hz, respectively) presented via headphones. These results suggest that spatial separation decreases perceived roughness, especially for tones with frequencies higher than the threshold at which interaural time differences rival interaural level differences for sound localization (approximately 2.3 kHz) and that the current roughness models need to be reviewed to include binaural effects. `http://acousticalsociety.org/meetings/san_francisco/`

[mcohen-15:2013] Michael Cohen, Rasika Ranaweera, Kensuke Nishimura, Yuya Sasamoto, Tomohiro Oyama, Tetunobu Ohashi, Anzu Nakada, Julián Villegas, Yong Ping Chen, Sascha Holesch, Jun Yamadera, Hayato Ito, Yasuhiko Saito, and Akira Sasaki. Augmented Virtuality Twirling. In *ICAT: Proc.* **I***nt.* **C***onf. on* **A***rtificial Reality and* **T***ele-Existence*, page Poster Demonstration, Tokyo, dec 2013.

We explore flexible mapping of real-world position data into augmented virtuality scenes to allow logical and visual alignment by a user twirling a mobile affordance, resolving the conflicting points of view represented by mirrored and tethered perspectives. "Tworlds" uses haptic interfaces featuring smartphones and tablets that use magnetometer-derived orientation sensing as a kind of affordance motion capture to control multimodal output. Either static (point-

ing) or dynamic (twirling) modes can be used to modulate multimodal displays. A user, assumed to be monitoring her avatar and affordance, desires logical and visual alignment for natural situation awareness. By twirling or by separate control, the "camerabatic" virtual perspective can display frontal or dorsal views of a self-identified puppet. In particular, a phase-locked "inspection gesture" which whirls around causes the strategically self-conscious avatar to alternate virtual manipulating hand to preserve intuitive projection.

[mcohen-16:2013] Michael Cohen, Rasika Ranaweera, Kensuke Nishimura, Yuya Sasamoto, Shun Endo, Tomohiro Oyama, Tetunobu Ohashi, Yukihiro Nishikawa, Ryo Kanno, Anzu Nakada, Julián Villegas, Yong Ping Chen, Sascha Holesch, Jun Yamadera, Hayato Ito, Yasuhiko Saito, and Akira Sasaki. "Twirled Affordances, Self-Conscious Avatars, & Inspection Gestures. In *Symp. on Mobile Graphics and Interactive Applications*, page Poster Demonstration, Hong Kong, nov 2013.

We explore the potential of self-conscious avatars, not in the sense of self-aware artificial intelligence, but rather figurative projections that can not only display real-world data in mixed virtuality environments but also automatically accommodate virtual camera position to maintain visual and logical consistency with human users. Like television or movie actors who adjust their pose to complement a camera point-of-view, our avatars are aware of virtual camera position, and, by implication, the projection mode of an active human pilot assumed to be visually monitoring the scene— projected, dorsal "tethered" perspectives or reflected, frontal "mirror" perspective. Avatars and virtual objects in our "Tworlds" scenes, including virtual cameras, are rigged to be driven by such twirling mobile devices. A unique feature of the rigging is that the avatars are strategically ambidextrous: although a human player typically uses a particular hand for twirling, as the viewpoint moves around, the puppets dynamically switch hands, even while the prop is whirling, to allow intuitive visual and logical alignment by the human user facing a monitor. By synchronizing rotation about its axis with revolution around an object of regard, the avatar projection of a human pilot, a phase-locked virtual camera expresses an "inspection gesture," like the tidally locked moon orbiting the Earth. When the

virtual camera is in front of it, the self-conscious avatar presents itself as a reflected image of the user, and when the camera circumferentially swings behind, the same avatar manifests a classic "FPS" (first-person shooter) projection of the user. Our adaptive Tworlds application leverages the alignment of the locally horizontal orientation of compass-derived yaw data, the symmetrically bilateral anatomy of humans and figurative avatars, and the horizontal orientation of an inspection or spin-around gesture.

[mcohen-17:2013] Michael Cohen, Yannis Haralambous, and Boris Veytsman. The Multibibliography Package. In *TUG: The 34th Annual Meeting of the TEX Users Group*, pages 83–89, oct 2013.

Conventional standards for bibliography styles entail a forced choice between index and name/year citations and corresponding references. We reject this false dichotomy, and describe a multibibliography, comprising alphabetic, sequenced, and also chronological orderings of references. An extended inline citation format is also presented which integrates such heterogeneous styles, and is usable and useful even without separate bibliographies. Richly hyperlinked for electronic browsing, the citations are articulated to select particular bibliographies, and the bibliographics are cross-referenced through their labels, linking among them. `http://tug.org/tug2013/`, `http://www.ctan.org/pkg/multibibliography`

[mcohen-18:2013] Michael Cohen, Rasika Ranaweera, Kensuke Nishimura, Yuya Sasamoto, Shun Endo, Tomohiro Oyama, Tetunobu Ohashi, Yukihiro Nishikawa, Ryo Kanno, Anzu Nakada, Julián Villegas, Yong Ping Chen, Sascha Holesch, Jun Yamadera, Hayato Ito, Yasuhiko Saito, and Akira Sasaki. "Tworlds": Twirled Worlds for Multimodal 'Padiddle' Spinning & Tethered 'Poi' Whirling. In *SIGGRAPH*, page Poster, Anaheim, California, jul 2013.

We have built haptic interfaces featuring smartphones and tablets that use magnetometer-derived orientation sensing to modulate virtual displays. Embedding such devices into swinging affordances allows "padiddle"-style interfaces, spinning a flatish object, and "poi"-style interfaces, whirling a tethered device, for novel interaction techniques. Either static (pointing) or dynamic (twirling) modes can be used to modulate multimodal displays, including

panoramic ("panos") imagery and object movies ("turnos"), spatial sound, and the positions of avatars and objects in virtual environments. Whirling can also sequence musical streams, playing a song as if operating an exotic, score-following "orgel" music box. A novel feature of our rigging is that the avatars are ambidextrous: although a human player typically uses a particular hand (usually the right), as the viewpoint moves between reflected, frontal "mirror" and projected, dorsal perspectives, the puppet dynamically switches hands, even while the prop is whirling. These active "exertoys" represent physical affordances for whole body interaction, "practically panoramic" multimodal interfaces that can be enjoyed as location-based entertainment systems for cross-platform, "mobile ambient" applications and experience.

Unrefereed Papers

[nisim-01:2013] Chamila Karunatilake and Satoshi Nishimura. Music Classification based on Chord Progression using Markov Models and Self Organizing Maps. In *Proc. of the 2013 Tohoku-Section Joint Convention of Institutes of Electrical and Information Engineers*, page 5, August 2013.

[nisim-02:2013] Hiroaki Yui and Satoshi Nishimura. A Novel Graph-Based Partitioning Algorithm. In *Proc. of the 2013 Tohoku-Section Joint Convention of Institutes of Electrical and Information Engineers*, page 171, August 2013.

Grants

[mcohen-19:2013] Michael Cohen and Rasika Ranaweera. Folkways in Wonderland: Cape Breton, 2014.

Social Sciences and Humanities Research Council of Canada

Academic Activities

[mcohen-20:2013] Michael Cohen, March 2013–14.

Executive Committee, IEEE Computer Society Technical Committee on Computer-Generated Music

[mcohen-21:2013] Michael Cohen, 2013–14.

Voting Member

[nisim-03:2013] Satoshi Nishimura, August 2013.

Co-Treasurer, 2013 Tohoku-Section Joint Convention of Institutes of Electrical and Information Engineers

Ph.D and Others Theses

[julian-12:2013] Yukihiro Chiba. Moving in virtual world in coordination with real world by using smart phones, University of Aizu, Mar 2013.

[julian-13:2013] Wataru Sanuki. 'Machi-Beacon': Spatial Sound For Mobile Navigation System, University of Aizu, Mar 2013.

This research explores the development of mobile navigation systems using spatial sound. A combination of spatial sound and geographic information allows mobile device users to perform auditory localization tasks while their eyes, hands, and attention are occupied. We created a spatial sound and simple navigation system using Unity. This navigation system informs user orientation to a goal and distance between present place and that point. The system runs on iOS and Android OS. Preliminary results indicate that a combination of spatial sound GPS and GIS can be used for navigation. This research was presented at the "Aizu Industry IT Technology" contest where it won an Encouragement Prize.

[julian-14:2013] Kodai Sakui. Implementing an A-weighting filter as an external object in Pure-data, University of Aizu, Mar 2013.

This research aimed the construction of A-weighting filter as an external object in Pd. C language was used for building the external. The same processing as actual A-weighting and created external object to perform, and the result was compared using a graph. Similar result were obtained in the middle frequency range. But, for low frequencies (under 100 Hz), values differed noticeably.

[mcohen-22:2013] Nakada Anzu; 中田 杏; 小山 朋浩 (s1180027). Graduation Thesis: "Integrating the Collaborative Virtual Environment Proto-

col with Mathematica; 協力的な仮想環境プロトコルと Mathematica の統合", University of Aizu, 2013–14.

Thesis Advisor: Michael Cohen

[mcohen-23:2013] Suzuki Taiki; 鈴木 大貴 (s1180183). Graduation Thesis: "Approach Object and Bluetooth Detection with Unmanned Air Vehicle; 無人航空機による、物体への接近と Bluetooth を用いた発見", University of Aizu, 2013–14.

Thesis Advisor: Michael Cohen

[mcohen-24:2013] Sakui Kodai; 作井 宏大; 白倉 潤一 (s1150095). Graduation Thesis: "Developing audio filter patch in PureData; PureData におけるの音響フィルターの開発", University of Aizu, 2013–14.

Thesis Advisor: Julián Villegas & Michael Cohen

[mcohen-25:2013] Kaneko Tomoko; 兼子 智子 (s1180052). Graduation Thesis: "Facial Animation Control with MEL script for Maya", University of Aizu, 2013–14.

Thesis Advisor: Michael Cohen with Incheon Paik

[mcohen-26:2013] Saji Akira (d8082102). Doctoral Dissertation: "Researches on HRTF-based 3D sound systems: learning effect, vertical sweet spot and reverberation", University of Aizu, 2013–14.

Doctoral Dissertation Referee: Michael Cohen

[mcohen-27:2013] Keita Tanno; 丹野 慶太 (d8101108). Doctoral Dissertation: "Development of a 3D sound system by horizontally arranged loudspeakers", University of Aizu, 2013–14.

Doctoral Dissertation Referee: Michael Cohen

[mcohen-28:2013] Saji Akira (d8082102). Doctoral Disseration: "Researches on HRTF-based 3D sound systems: learning effect, vertical sweet spot and reverberation", University of Aizu, 2013–14.

Doctoral Dissertation Referee: Michael Cohen

[mcohen-29:2013] Chiba Yukihiro; 千葉 行博 (s1170202). Graduation Thesis: "Navigating in virtual worlds using smart phones: Reflecting real world motion in virtual environments; スマートフォンによる現実世界での移動と一致させたバーチャル世界での移動", University of Aizu, 2013–14.

Thesis Advisor: Julián Villegas & Michael Cohen

[mcohen-30:2013] Sakai Takemitsu; 酒井 健充 (s1180017). Graduation Thesis: "Visualization of the center of gravity and posture: Attitude

of the adult male skeleton before and after correction of the lower jaw; 姿勢と重心の可視化:下顎の骨格矯正前後の成人男性の姿勢", University of Aizu, 2013–14.

Thesis Advisor: Michael Cohen

[mcohen-31:2013] Sanuki Wataru; 讃岐 航 (s1180020). Graduation Thesis: "Spatial Sound For Mobile Navigation System; 携帯型道案内システムのための立体音響", University of Aizu, 2013–14.

Thesis Advisor: Julián Villegas & Michael Cohen

[nisim-04:2013] Haruki Tamura. Graduation thesis: A system for matching music and color in stage lighting using pitch class profiles, University of Aizu, 2014.

Thesis Advisor: S. Nishimura

[nisim-05:2013] Yuki Kamada. Graduation thesis: A Score-Following System for Wave Signals Using Hidden Markov Models, University of Aizu, 2014.

Thesis Advisor: S. Nishimura

[nisim-06:2013] Syohei Sakamoto. Graduation thesis: Fast Nearest-Neighbor Search in Photon Mapping Using a Graphics Processing Unit (GPU), University of Aizu, 2014.

Thesis Advisor: S. Nishimura

[nisim-07:2013] Hiroki Sato. Graduation thesis: Fast calculation of ray-object intersection by dedicated hardware, University of Aizu, 2014.

Thesis Advisor: S. Nishimura

[nisim-08:2013] Sho Fuchiwaki. Graduation thesis: Acoustic and Non-Acoustic Characteristics of Refusal Speech, University of Aizu, 2014.

Thesis Co-Advisor: S. Nishimura

Others

[mcohen-32:2013] Sanuki Wataru; 讃岐 航. "Machi-Beacon";「町ビーコン」. "Aizu Industry IT Technology";「会津産ＩＴ技術認定証授与式兼産学連携フォーラム」contest, Jan. 2014.

Aizu IT Forum Encouragement Prize. Supervised by Julián Villegas and Michael Cohen.