Ivica Ico Bukvic

Empowering the Society through
Ubiquitous Interactivity

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Statement

I am a scholar-practitioner exploring new interactive technologies in a pursuit of quantifiable improvement of the quality of life. I design innovative artifacts and solutions that empower and inspire. From the K-12 education to industry, health to gaming, digital signal processing to multisensory immersion, my ongoing research spans multiple modalities and the resulting technologies have seen international adoption. Increasingly embracing an administrative role, I lead by example and, once again, seek to empower and inspire. As a passionate originator I thrive in dynamic, open, progressive, and experimental environments that challenge traditional norms and pursue betterment through incessant innovation.

Work Experience

2006 – Present

Assoc. Prof. Creative Technologies in Music, Virginia Tech
Institute for Creativity, Arts, and Technology (ICAT) Senior Fellow
Founder & Director, Digital Interactive Sound & Intermedia Studio (DISIS) and the Linux Laptop Orchestra (L2Ork)

As one of the four transdisciplinary cluster hire researchers introduced a series of new programs centered around ubiquitous interactivity in the Arts and Engineering with particular focus on sound and music. Spearheaded over $1M in funded research projects. Secured over $1M in internal support for new programmatic and research infrastructure. One of the founding members of the new Institute for Creativity, Arts, and Technology, a stakeholder in the creation of the $100M Moss Arts Center (2013), and a key consultant in the creation of the Cube, a $30M holodeck-like immersive space. Assistant Co-Director of the Collaborative for Creative Technologies in the Arts and Design (08-12).

2005 – Present

Linuxaudio.org International Consortium Director (elected)

Built international network of partners and stakeholders, and consolidated online presence of a diverse community of Linux audio and multimedia software engineers, organizations, and companies, into a largest resource of its kind in the world. Ongoing pursuit of support and resources, and managing a growing team of volunteers maintaining online resources with 6+TB of monthly traffic.

2005 – 2011

SEAMUS Board Member (elected)

Board member and treasurer for the Society for Electro-Acoustic Music in the United States (SEAMUS) 501c3 national organization. Managing finances and participating in the daily operations. By the time I left the position, the organization's operating budget was in the black, while supporting a number of new programs and initiatives.

2004

Visiting Professor, Oberlin College

Taught topics in music technology covering interactive computer music, sound synthesis, and digital signal processing at the oldest Conservatory in Northern America.

Education

Management Academy, Virginia Tech, 2014-5.

D.M.A. in Composition (cognates in Computer Music Programming and Music Theory), University of Cincinnati, College-Conservatory of Music, 2005.

M.M. in Composition, University of Cincinnati, College-Conservatory of Music, 2001.

B.M. in Composition (Summa Cum Laude), University of Cincinnati, College-Conservatory of Music, 1998.

Attended X Gymnasium in Informatics (Zagreb, Croatia), 1989-1992; finished senior year in New Carlisle, Ohio, USA, 1993.

Competencies

- Problem Solving
- Project Management
- Financial Management
- Micromanagement
- Time Management
- Leadership
- Communication
- Creativity
- Goal Oriented

Technical Skills & Interests

- Digital Signal Processing
- Audio Spatialization
- Sound Design
- Visualization
- Embedded Systems
- Immersive Environments
- Computer Vision
- Sensing & Biofeedback

Select Programming Languages, Frameworks, and APIs

C, Java, C#, C++, Max, Pure-Data, Unity3D, Android, OpenGL, Python, JavaScript, CSS, GitHub, SVN

Languages

- English
- Croatian
- Russian
- German
- French
- Latin

Key Projects

D^4 (2014-present)

D^4 is a comprehensive audio spatialization library for the Max visual programming language. It consists of two components: an innovative Layer Based Amplitude Panning (LBAP) algorithm first publicly introduced at the ICAD 2016 conference in Canberra, Australia, and a multimodal Max library designed to optimize the use of the LBAP algorithm in immersive scenarios utilizing High Density Loudspeaker Arrays, including VR, and AR.

Cinemacraft (2016-present)

Building upon the success of OPERAcraft (see below), the project continues to expand the real-time machinima potential within the reverse-engineered Minecraft mod by integrating Kinect HD facial recognition and full body motion, and expanded array of Machinima production features.

Mirror Worlds (2014-present)

A project funded by the National Science Foundation focusing on the research of an infrastructure that would bridge the virtual and real. A series of spaces were retrofitted by an array of sensing equipment (e.g. cameras, microphones, Kinect, etc.) to capture physical presence and map it onto their virtual counterparts that also reflected virtual activity (e.g. online participants exploring the virtual space). Likewise, where possible, virtual presence was also reflected in a real world using aural and visual cues. The ensuing ecosystem offered opportunities for interaction across the real-virtual divide. The project in part served as an inspiration for the Cinemacraft project above.

Orb (2014-present)

A project whose pending commercialization is in part funded by the National Science Foundation I-Corps program. Orb focuses on the visualization of hidden connections and their exploration using Leap Motion interface. The project's initial goal was to map activity within a Virginia Tech institute. Its implementation has served as a foundation for the institute's restructuring and has since been utilized in an array of externally funded projects, including NASA's Unmanned Systems database.

Glasstra (2014-5)

A Google Glass application that allows for dynamic creation and updating of a widget-based GUI projected onto Glass' display via a simple network-enabled protocol. It was utilized in conjunction with the Pd-L2Ork visual programming language as a conductor score system for the Linux Laptop Orchestra.

OPERAcraft (2013-5)

A reverse-engineered Minecraft mod that implements real-time mouth movement based on singer's voice recognition, simple arm gestures, camera views, cross-fades, teleportation checkpoints, subtitles, and stage cuing engine for the purpose of staging a real-time Opera within Minecraft. The entire opera was implemented by middle- and high-school students as part of University's K-12 outreach initiative. The standing room only premiere was also broadcast online in real-time to an audience of 30,000 viewers. The second version also implemented multiple camera views, and invisible spectators that could observe the theatrical performance, a musical machinima from their own preferred vantage point. The project served as a foundation for the Cinemacraft project above.

Drummer Game (2011)

A project funded by the National Science Foundation focused on the implementation of an interactive multimedia spectacle featuring Chinese terracotta soldiers. Two teams consisting of six drummers controlled six cohorts of terracotta soldiers and issue orders to their respective cohort using a series of rhythmic patterns, each representing a particular command. The goal of the spectacle is simple–beat the other army. The project required a series of newly developed technologies and their respective research vectors, including GPU-based crowd simulation, an unconventional approach to analog signal input and analysis from a series of authentic and resonant Chinese war drums, including a combination of dynamic time warping and "binpass" FFT filtering and amplitude tracking, and AEGIS, a new situation-aware soundtrack engine that provides seamless and musically satisfying transitions between different states (e.g. attack, retreat, march, stand, win, loss, etc.) by ensuring that all transitions occur on a downbeat, obey the meter and tempo (including changing tempi), and pull transitioning material from a database of appropriate options (based on the combination of starting and ending states).

Pd-L2Ork (2010-present)

A fork of Pure-Data, a visual dataflow programming language geared towards real-time low-latency digital signal processing with focus on audio. It offers over 1,500 bug-fixes and usability improvements, and introduces a unique K-12 learning module that scales with students' skillset from beginner to professional. It is used as the foundation for the Linux Laptop Orchestra (including the most advanced free open source Wiimote connectivity library), and for over dozen K-12 Maker camps held since 2012 that utilize Arduino and Raspberry Pi hardware, including the inaugural 2014 Raspberry Pi Orchestra summer gifted program. The software continues to be used internationally in K-12 scenarios, by artists, engineers, and researchers.

L2Ork (2009-present)

One of my most ambitious projects focusing on the design of a laptop ensemble to teach a seamlessly integrated combination of science, technology, engineering, math, arts, and design. The ensemble uses Taiji (Tai Chi) mind-body practice as the foundation for choreography, custom designed hemispherical speakers fashioned out of IKEA salad bowls, low-latency kernels and optimizations for real-time audio performance, and Wiimotes as an affordable means for motion capture. The ensemble's infrastructure is intentionally optimized for minimal cost overhead to allow for its introduction in K-12 scenarios, including an ongoing partnership with the Boys & Girls Club of Southwestern Virginia. Students participating in the class are tasked to design their own instruments using Pd-L2Ork programming environment (see above), including custom GUIs, networked sync, and scoring mechanisms, iteratively improve upon those designs, rehearse, and eventually premiere their creations in front of a live audience. As a result, they are given a unique opportunity to explore product lifecycle from ideation to iterative design and eventual production. Through awards and media attention the ensemble has also received international acclaim.

myu (2008)

A Max-Unity3D interoperability toolkit designed to cross-pollinate rapid prototyping power of the two programming environments with Max offering unprecedented flexibility and low-latency performance in the audio domain. To this day, the software continues to be downloaded hundreds of times very month.

Mind Body Interactive (MBI) (2008-2012)

MBI explores the use of Taiji (Tai Chi) and technology to promote mindfulness and exercise. Predating many of the current digital fitness trainers it was introduced in multiple iterations. First focused on 3rd graders who practiced Taiji postures and were monitored using reverse-engineered Wii Fit board. The second focused on the college students utilizing minimal amount of sensing equipment, and the third on distance learning as the first of its kind online mind-body practice system. Latest prototype focused on sensory fusion, including biofeedback sensors and Kinect to improve system's accuracy and use in preventative care.

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Recognition Highlights

L2Ork recognized one of the top six transdisciplinary exemplars in the United States (a2ru, 2015).

OPERAcraft featured in the Greg Toppo's (USA Today) book The Game Believes in You: How Digital Play Can Make Our Kids Smarter (2015).

L2Ork named as one of the "eight awesome research projects at Virginia Tech" (DCist, 2015).

Virginia Tech XCaliber award for "for exceptional, high caliber contributions to technology-enriched teaching and learning" (VT, 2010).

TedXMidAtlantic (2009).

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Key Research Publications

Bukvic, I. (2016). "3D TIME-BASED AURAL DATA REPRESENTATION USING D4 LIBRARY'S LAYER BASED AMPLITUDE PANNING ALGORITHM." International Conference on Auditory Displays (pp. Pending). Canberra, Australia.

Bukvic, I., and *Matthews M. (2015). "AEGIS AUDIO ENGINE: INTEGRATING A REAL-TIME ANALOG SIGNAL PROCESSING, PATTERN RECOGNITION, AND A PROCEDURAL SOUNDTRACK IN A LIVE TWELVE-PERFOMER SPECTACLE WITH CROWD PARTICIPATION." International Conference on Auditory Displays (pp. 35-43). Graz, Austria: IEM.

Bukvic, I., *Cahoon, C., Wyatt, A., Cowden, T., Dredger, K. (2014). "OPERAcraft: Blurring the Lines between Real and Virtual. "International Computer Music Conference, Athens, Greece.

Bukvic. I. (2014). Pd-L2Ork Raspberry Pi Toolkit as a Comprehensive Arduino Alternative in K-12 and Production Scenarios. New Interfaces for Music Expression (pp. 163-6). London, UK: NIME.

Bukvic, I., Baum, L., *Layman, B., and *Kendall, W. (2012). Granular Learning Objects for Instrument Design and Collaborative Performance in K-12 Education. New Interfaces for Music Expression (pp. 344-346). Ann Arbor, Michigan: NIME.

Bukvic, I., S. Betz. (2011). "USING GAMING ENGINE FOR VIRTUAL PROTOTYPING AND IMPACT ASSESSMENT OF COMPLEX INTERACTIVE ART INSTALLATIONS." International Computer Music Conference, Huddersfield, United Kingdom.

Bukvic, I., T. Martin, E. Standley and *Michael Matthews. "Introducing L2Ork: Linux Laptop Orchestra."New Interfaces for Music Expression conference, Sydney, Australia, June 15-18, 2010.

Bukvic, I. and *Ji-Sun Kim. (2010). "PERCEPTION AND INTERPRETATION OF CONCURRENT AURAL SHAPES USING DREAM INTERFACE." International Computer Music Conference, Stony Brook, New York.

Bukvic, I. and Ji-Sun Kim. (2009). "μ MAX-UNITY3D INTEROPERABILITY TOOLKIT." International Computer Music Conference, Montreal, Canada, 375-378.

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Select Artistic Creations

Rain – a work for Linux Laptop Orchestra (L2Ork) and French Horn, 2012, rev. 2015.

Tornado – real-time simulation of a tornado designed specifically for the Institute for Creativity, Arts, and Technology's (ICAT) Cube audio system with 128-channel sound diffusion, 2014.

Cloud – interactive community-driven audio-visual installation with 50 community-programmed Raspberry Pis (in collaboration with Aki Ishida), 2013-2014.

Between – composition for the Linux Laptop Orchestra (L2Ork) and Saxophone, 2013.

FORGETFULNESS – interactive audio-visual setting of a poem by Denise Duhamel using Unity3D, 2009.

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Select Press

Robertson, A. (March 13, 2015). Step into the Cube: Virginia Tech's giant virtual reality room. Retrieved March 13, 2015, from http://www.theverge.com/2015/3/13/8204193/virginia-tech-icat-vr-research-oculus-rift

Flood, B. (February 8, 2015). TWC's Cantore, Forbes Walk Inside Virtual Tornado. Retrieved February 10, 2015, from http://www.adweek.com/tvnewser/twcs-cantore-forbes-walk-inside-virtual-tornado/254981

Haglund, D. (December 9, 2013). Minecraft, the Opera. Retrieved March 23, 2014 from http://www.slate.com/blogs/browbeat/2013/12/09/operacraft_minecraft_opera_streams_online_watch_video.html

Philips, Inc. (October, 2013). Lantern Field, the Smithsonian Freer Gallery of Art. Retrieved March 23, 2014 from http://www.colorkinetics.com/showcase/installs/Lantern-Field-Smithsonian/

eHrvatska 88 – L2Ork, Linux Laptop Orchestra . (May 28, 2011). Retrieved August 20, 2011, from http://www.youtube.com/watch?v=PI3uZtoxT4I

Phillips, D. (2010). Introducing L2Ork: The Linux Laptop Orchestra. Linux Journal, 193, cover & 50-57.

Kirn, P. (December 31, 2009). CDM's Biggest Music Tech Stories of 2009. Retrieved January 1, 2010, from http://createdigitalmusic.com/2009/12/31/cdms-biggest-music-tech-stories-of-2009/

Introducing L2Ork, World's First Linux Laptop Orchestra. (December 3, 2009). Retrieved January 1, 2010, from http://slashdot.org/story/09/12/03/2018253/Introducing-L2Ork-Worlds-First-Linux-Laptop-Orchestra

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