Crossing boundaries: arts and technology of emotions

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www.casapaganini.org

12th International Conference on Affective Computing & Intelligent Interaction
Glasgow, UK, September 15-18, 2024

infomus casa Paganini

InfoMus- Casa Paganini Research Centre

University of Genoa

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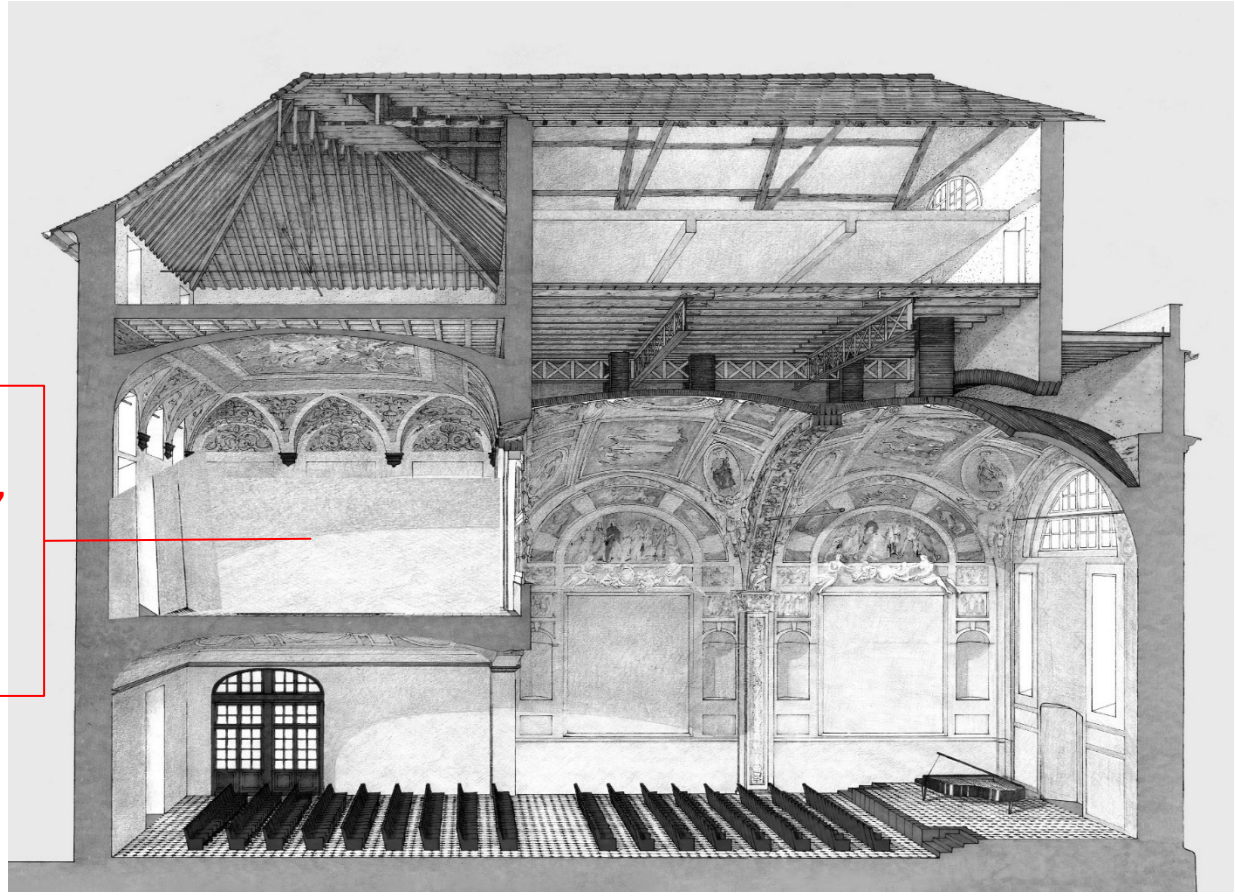
University of Genoa

A dedicated lab room enjoys a direct view on the main lab room, simulating a concert room or an “open space” (e.g. a museum space with no chairs)

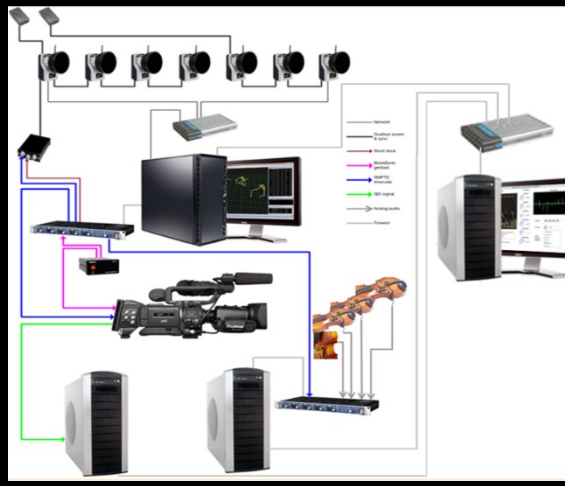


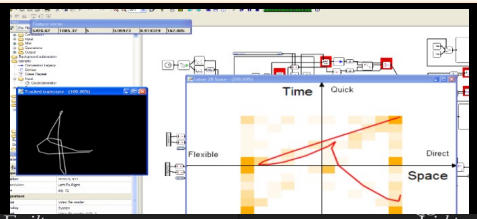
Santa Maria delle Grazie la Nuova: a monumental building as a research facility on art-inspired R&D on affective computing and intelligent interaction.

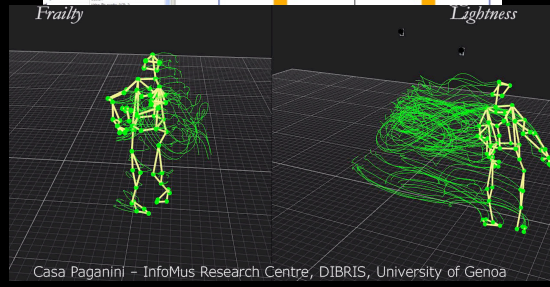
InfoMus-Casa Paganini Research Centre, University of Genoa

www.casapaganini.org

32-camera Qualysis MoCap system, synchronized with videocameras, biometric sensors (IMU, EMG, ECG), and with multichannel audio I/O







Video demos:

- http://dance.dibris.unige.it/index.php/dance-media
- https://entimement.dibris.unige.it/events/34-timesregained-at-the-futuretech-week-2020
- http://www.casapaganini.org/atempo/

Casa Paganini trans-disciplinary approach

- Artistic and humanistic theories as source of inspiration for human-centric interactive systems
- Scientific and technological results as source of inspiration for art languages and artistic projects

A.Camurri, G.Volpe (2016) The Intersection of art and technology. *IEEE Multimedia*, 23(1).

Art-led research at InfoMus-Casa Paganini

Cronaca del Luogo, opera by Luciano Berio opening the Salzburg Festival, July 1999.

A.Camurri, P.Ferrentino (1999) Interactive environments for music and multimedia, ACM Multimedia systems.

A.Camurri, S.Hashimoto, M.Ricchetti, R.Trocca, K.Suzuki, G.Volpe (2000) EyesWeb - Toward gesture and affect recognition in dance/music interactive systems. Computer Music Journal, MIT Press.

A.Camurri, G.Volpe (2016) The Intersection of art and technology. *IEEE Multimedia*, 23(1).

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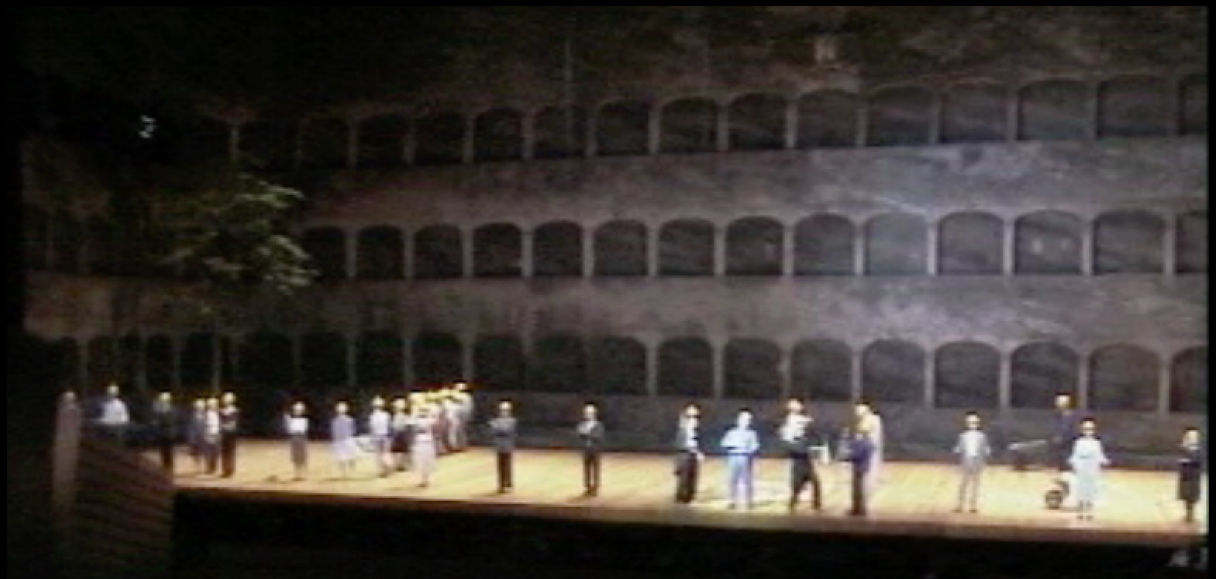


Artistic scenario: in-the-wild, reaı-tıme

To analyze the "schizophrenic" behavior of the main protagonist (performer David Moss) and use the analysis result to process his voice in real time (morphing between profound/wise Vs harsh/crazy): integration and sync of on-body sensors and videocameras

Requirements for the EyesWeb software platform, first version released in 2001

A.Camurri, P.Ferrentino (1999) Interactive environments for music and multimedia, ACM Multimedia systems.

A.Camurri, S.Hashimoto, M.Ricchetti, R.Trocca, K.Suzuki, G.Volpe (2000) EyesWeb - Toward gesture and affect recognition in dance/music interactive systems. Computer Music Journal, MIT Press.

A.Camurri, G.Volpe (2016) The Intersection of art and technology. *IEEE Multimedia*, 23(1).

Art-led research at InfoMus-Casa Paganini

Atlante del Gesto, Virgilio Sieni, Palazzo Reale, Genoa, Nov.2016-March 2017

http://dance.dibris.unige.it/index.php/dance-media

R.Niewiadomski, M. Mancini, A. Cera, S. Piana, C. Canepa, A. Camurri (2019) Does embodied training improve the recognition of mid-level expressive movement qualities sonification? Journal on Multimodal User Interfaces.

A.Camurri, G.Volpe (2016) The Intersection of art and technology. *IEEE Multimedia*, 23(1).

Art-led research at InfoMus-Casa Paganini

6FP NoE HUMAINE and 7FP FET ICT SIEMPRE EU Projects (siempre.infomus.org 2010-2013)
Music performance to investigate emotion, expressive gesture, non verbal social signals

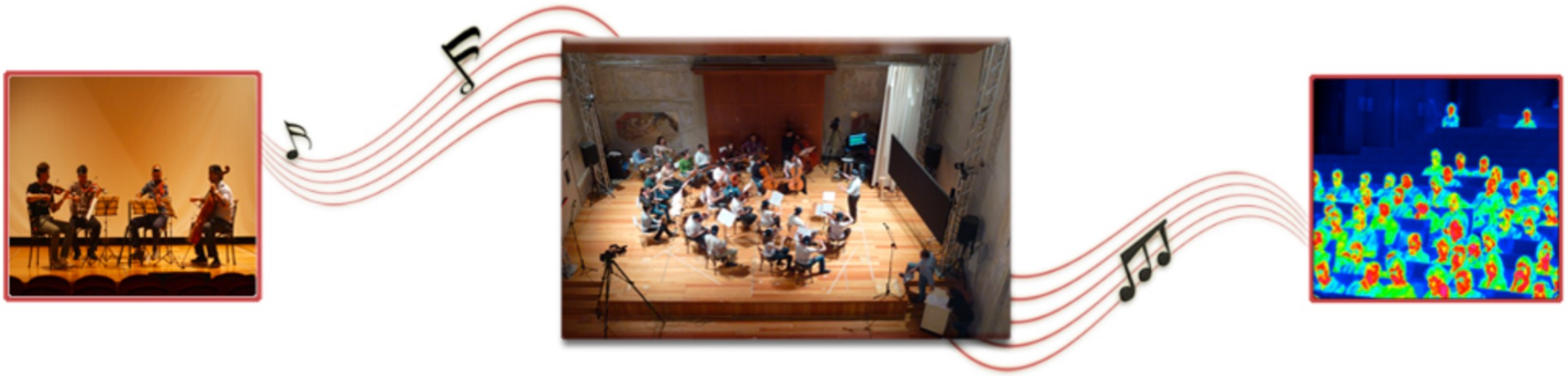
SOCIAL INTERACTION ENTRAINMENT USING MUSIC PERFORMANCE SIEMPRE

EU 7 Framework Programme ICT
FET — Future and Emerging Technologies

http://siempre.infomus.org/ (see "Media" and "Publications")

Home Description Consortium News Events Publications Media Repository Forum Private

Home

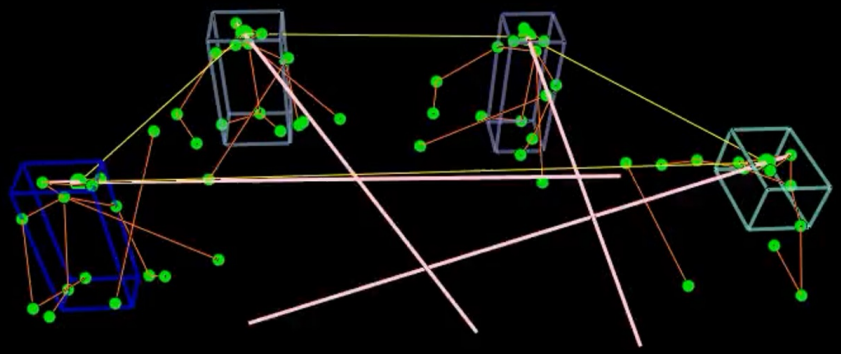


The goal of the **SIEMPRE** project is to develop novel research theoretical and methodological frameworks, computational models, and algorithms for the analysis of creative communication within groups of people. Research in SIEMPRE is focused on ensemble musical performance and audience experience, an ideal test-bed for the development of models and techniques for measuring creative social interaction in an ecologically valid framework. In particular, the focus is on exploring interpersonal interaction in

1. **musician-musician**
2. **conductor-musicians**
3. **music-listener**
4. **musician-listener scenarios.**

Art-led research at InfoMus-Casa Paganini

6FP NoE HUMAINE and 7FP FET ICT SIEMPRE EU Projects: string quartets inspiring novel automated analysis techniques of social behavior in self-managed groups (siempre.infomus.org)



Video demos of InfoMus Projects, including experiments with string quartets:
https://www.youtube.com/watch?v=J1Q4eOlnvRI&t=312s
More video demos:

youtube.com/InfoMusLab
dance.dibris.unige.it
siempre.infomus.org
entimement.dibris.unige.it

G.Varni, G.Volpe, A.Camurri (2011) A System for Real-Time Multimodal Analysis of Nonverbal Affective Social Interaction in User-Centric Media. IEEE Transactions on Multimedia

D.Glowinski, M.Mancini, R.Cowie, A.Camurri, C.Chiorri, C.Doherty (2013) The movements made by performers in a skilled quartet: a distinctive pattern, and the function that it serves. Frontiers in Psychology.

A.D'Ausilio, L.Badino, D.Glowinski, A.Camurri, L.Fadiga (2013) Sensorimotor communication in professional quartets. Journal of NeuroPsychology

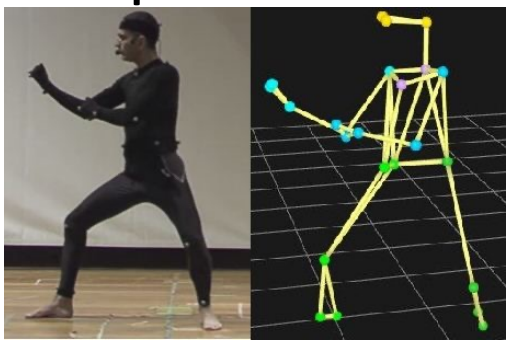
Examples of trans-disciplinary art-science projects at Casa Paganini research centre of University of Genoa

Artistic projects…	…inspire S&T research
Music Theatre Opera “Outis” Luciano Berio Teatro Alla Scala di Milano (1996)	Invisible interfaces for on-stage interaction and synchronisation with audio
Music Theatre Opera “Cronaca del Luogo”, Luciano Berio, opening Salzburg Festival (July 1999)	Real-time analysis of full-body movement, non-verbal expressive behaviour qualities. The EyesWeb software platform.
Music Theatre Opera “Un Avatar del Diavolo”, Roberto Doati, La Biennale di Venezia	Tangible acoustic interfaces: give the sense of touch to everyday objects
Museum “Enrico Caruso”, permanent interactive installation	Visitors non-verbal behaviour analysis for active experience of Caruso voice
EU FET11 Closing Performance: “TanGO Touching Music”	Performance built upon scientific results of the European ICT FET SIEMPRE Project.
Study of music joint performance: string quartets, orchestra sections	S&T research in EU ICT FET SIEMPRE Project

Analysis of mid-level movement qualities (individual)

- Art-inspired techniques: to detect whether a movement is rigid, fluid, light, fragmented, hesitant, frail, impulsive, …

Examples



A world champion in karate Vs black belt athletes performing the same kata.
Even non expert observers (of mocap videos) recognize the world champion:
Which movement qualities explain the difference?

N.De Giorgis, E.Puppo, P.Alborno, A.Camurri (2019) Evaluating Movement Quality Through Intrapersonal Synchronization. *IEEE Trans Human-Machine Systems*

Analysis of mid-level movement qualities (individual)

- Origin of Movement

(a)

(b)

(c)

K.Kolykhalova, G.Gnecco, M.Sanguineti, G.Volpe, A.Camurri (2020) Automated Analysis of the Origin of Movement: An Approach Based on Cooperative Games on Graphs. *IEEE Trans Human-Machine Systems*

O.Matthiopoulou, G.Gnecco,, M.Sanguineti, D.Mottet, B.Bardy, A. Camurri (2024) Towards the Automated Analysis of Expressive Gesture Qualities in Full-Body Movement: The Perceived Origin of Movement. Human-centric Computing and Information Sciences

- Postural Tension

A. Camurri, G. Volpe, S. Piana, M. Mancini, P. Alborno, S. Ghisio (2018) The Energy Lift: Automated Measurement of Postural Tension and Energy Transmission. *Proc 5th International Conference on Movement and Computing MOCO 2018.*

Analysis of mid-level movement qualities (dyads and small groups)

- Leadership, Affective and Temporal Synchronization, Soft Entrainment:

G. Varni, M. Mancini, L. Fadiga, A. Camurri, G. Volpe (2019) The change matters! Measuring the effect of changing the leader in joint music performances. *IEEE Trans Affective Computing*,

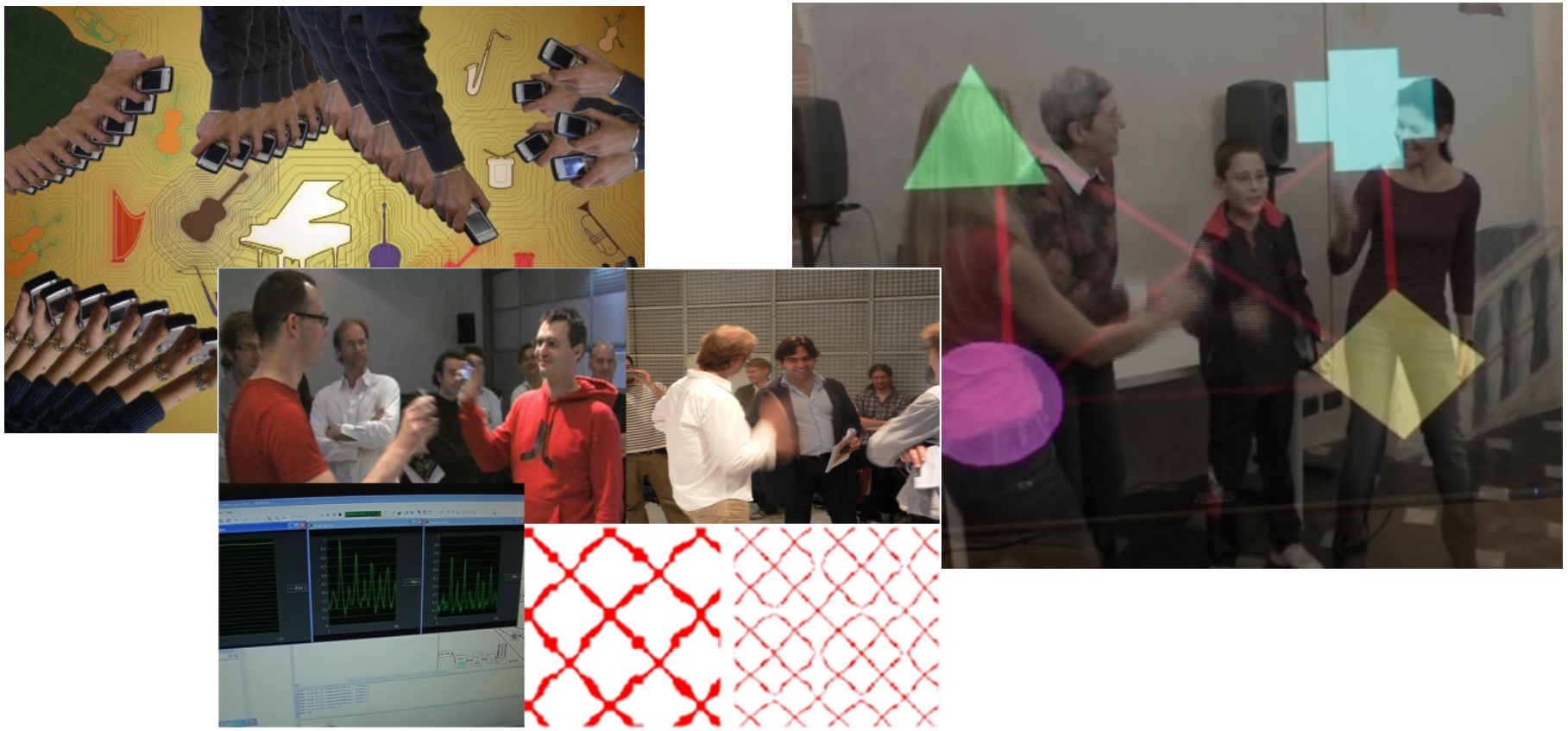
S.R.Sabharwal, M.Varlet, M.Breaden, G.Volpe, A.Camurri, P.E.Keller (2022) huSync - A Model and System for the Measure of Synchronization in Small Groups: A Case Study on Musical Joint Action. IEEE Access.

G.Varni, G.Volpe, A.Camurri (2011) A System for Real-time Multimodal Analysis of Nonverbal Affective Social Interaction in User-Centric Media. IEEE Transactions on Multimedia, 12(6).

How to validate mid-level movement qualities?

M. J Vaessen, E. Abassi, M. Mancini, A. Camurri, B. de Gelder 2019) Computational Feature Analysis of Body Movements Reveals Hierarchical Brain Organization. Cerebral Cortex

Active social experience of multimedia content, exploiting full-body movement qualities



G. Volpe and A. Camurri (2011) A system for embodied social active listening to sound and music content. ACM Journal on Computing and Cultural Heritage, 4(1).

Embodied active listening EU FP7 ICT SAME project

Video demos:
https://www.youtube.com/watch?v=J1Q4eOlnvRI&t=312s
(This Sync'n'Move demo starts at 5'07")

G.Volpe and A.Camurri (2011) A system for embodied social active listening to sound and music content, ACM Journal on Computing and Cultural Heritage, 4(1).

G.Varni, G.Volpe, A.Camurri (2011) A System for Real-Time Multimodal Analysis of Nonverbal Affective Social Interaction in User-Centric Media. IEEE Trans. Multimedia, 12(6).

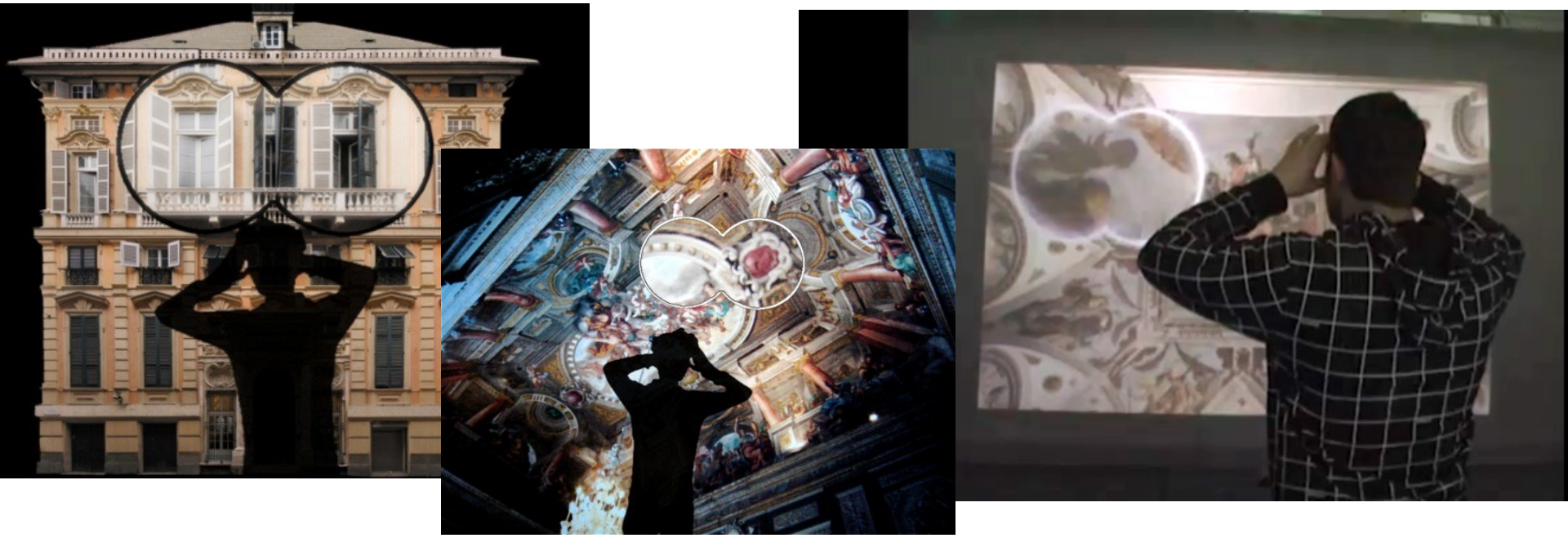
Closing Performance

Be captivated by the ability of dance to inhabit a physical space, create social interactions, and resonate the emphatic responses from your body. Linking tango music, technology and dance, Casa Paganini - InfoMus brings together artistic expression and science.

Active experience of cultural heritage: the *Viaggiatori di Sguardo* interactive installation,

Palazzo Ducale of Genoa, 2009-2011

Video: https://youtu.be/J1Q4eOlnvRI
(start at 3'30")



G.Volpe and A.Camurri (2011) A system for embodied social active listening to sound and music content. ACM Journal on Computing and Cultural Heritage, 4(1).

A.Camurri, P.Coletta, C.Canepa, F.Cavallero, S.Ghisio, D.Glowinski, and G.Volpe (2010) Active Experience of Audiovisual Cultural Content: the Virtual Binocular Interface. Proc. 2nd Workshop on Electronic Heritage and Digital Art Preservation (eHeritage'10).

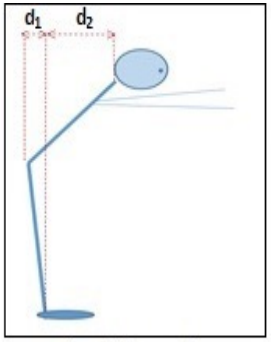
Expressive gesture – therapy and rehabilitation

Teaching emotion to autistic children

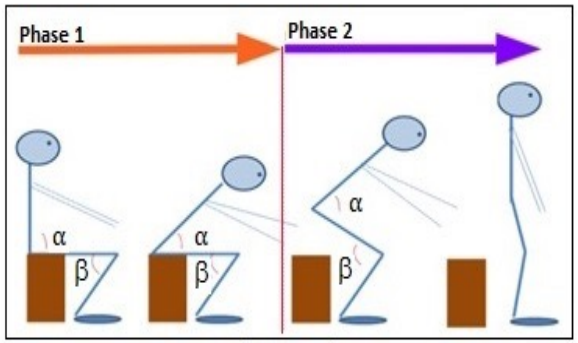
EU FP7 ICT ASC INCLUSION Project

S.Piana, A.Staglianò, F.Odone, A.Camurri, Adaptive Body Gesture Representation for Automatic Emotion Recognition, ACM Trans on Interactive Intelligent Systems, 6(1), 2016.

S. Piana, C. Malagoli, M. C. Usai, A. Camurri, Effects of Computerized Emotional Training on Children with High Functioning Autism", IEEE Transactions on Affective Computing, 2019.



Reach Forward



Sit-to-Stand

Recovering from chronic pain

UCLIC (UCL) and InfoMus-Casa Paganini

A.Singh, S.Piana, D.Pollarolo, G.Volpe, G.Varni, A.Tajadura-Jimenez, A.Williams, A.Camurri, N.Bianchi-Berthouze (2016) Go-with-the-Flow: Tracking, Analysis and Sonification of Movement and Breathing to Build Confidence in Activity Despite Chronic Pain. Human-Computer Interaction, 31(3-4), pp. 335-383.

Emotional Wellbeing Technologies

Treatment for Parkinson disease

Objective: reduce the hesitation in movement; quantitative evaluation of the hesitation.

The patient uses his body as a «brush» to paint on three walls in the room, and create a sonification: but only if his movement is fluid!

Paradigm of interaction:
Aesthetic Resonance
Slow Mood

EU ICT CARE HERE Project

A. Camurri, B. Mazzarino, G. Volpe, P. Morasso, F. Priano, C. Re (2003)
Application of multimedia techniques in the physical rehabilitation of Parkinson's patients
Journal of Visualization and Computer Animation, Wiley, 14(5)

DanzArTe Emotional Wellbeing Technologies

https://www.youtube.com/watch?v=OxJ0e8zums8

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Interactive sonification of movement qualities

- How to “translate” mid-level movement qualities to the auditory channel? Sensory substitution or enhancement: “to hear the dance” (DANCE EU ICT project: dance.dibris.unige.it)
  - Cross-modal correspondences (e.g. Spence 2011),
  - Cognitive neuroscience: which audio features? e.g. *spectral flux, beat salience* (e.g. Weineck, Xin Wien, Henry 2022)
  - Artistic theories: e.g., Pierre Schaeffer’s Morphology in Musique Concrete; Rudolf Laban’s Theory of Effort in dance

Niewiadomski, Mancini, Cera, Piana, Canepa, Camurri (2019) Does embodied training improve the recognition of mid-level expressive movement qualities sonification? *Journal on Multimodal User Interfaces*.

Camurri et al (2023) Development and validation of an art-inspired multimodal interactive technology system for a multi-component intervention for older people: a pilot study. Frontiers in Computer Science.

Barbagelata et al (2024) Resilience improvement through a multicomponent physical and cognitive intervention for older people: the DanzArTe Emotional Well-Being Technology project. Aging Clin Exp Res.

H2020 ICT DANCE (dance.dibris.unige.it): automated analysis and interactive sonification of *lightness* and *fragility*

https://youtu.be/V0uir8E1yeY

"An UnVeiled dance" video: examples on how we investigate mid-level qualities

We built an annotated multimodal dataset of expressive gesture, in collaboration with the choreographer Virgilio Sieni.

We develop software libraries for the (i) automated analysis of expressive gesture and (ii) interactive sonification based on cross-sensory correspondences

R. Niewiadomski, M. Mancini, A. Cera, S. Piana, C. Canepa, A. Camurri (2019)
Does embodied training improve the recognition of mid-level expressive movement qualities sonification?
Journal on Multimodal User Interfaces,

Interactive sonification of qualities of human movement

- Measure in real-time movement qualities and “translate” them to the auditory channel: Sensory substitution or enhancement: “to hear the dance”

https://www.youtube.com/watch?v=IhB6lJNMO6o&list=PLEVgkiAQI8zIFbTFv8I7ioEpuDHNbYsdC

Europa: Gestures of History Dancing Science and Art not to forget EU identity

Invited demo performance at EU Commission celebration of the Treaty of Rome

La Lanterna, Rome, March 2017

Giulia Mureddu, Dance
Virgilio Sieni and **Giulia Mureddu**, Choreography
Andrea Cera, Sonic design
Stefano Piana, EyesWeb software for the real-time analysis of movement qualities
A project of Casa Paganini-InfoMus Research Centre, University of Genoa, coordinated by **Antonio Camurri**

EU H2020 ICT DANCE Project 2015-2017 (Coordinator)

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How to assess and validate models of interactive sonification of movement qualities?

1. Assess computational models against neuroimaging measures of human participants:

M.J Vaessen, E. Abassi, M. Mancini, A. Camurri, B. de Gelder (2019)
Computational Feature Analysis of Body Movements Reveals Hierarchical Brain Organization
Cerebral Cortex

2. A family of serious games: compare different sonifications of the same movement feature against the embodied movement response of users exposed to the sonification (comparison of the measured movement quality of users against the movement feature that generated the sonifications).

K. Kolykhalova, P. Alborno, A. Camurri, G. Volpe (2016)
A serious games platform for validating sonification of human full-body movement qualities
in *Proceedings of the 3rd International Symposium on Movement and Computing*, ACM

A new trans-disciplinary Master Degree at InfoMus-Casa Paganini, University of Genoa (English language)

Affective Computing, Arts, and Cultural Welfare (ACW)
is the international track of the

Master's degree in *Digital Humanities – Interactive systems and digital media* at the University of Genova

Polytechnic School

https://digitalhumanities.dibris.unige.it/ACW-track-international/

Language: English – Location: Genoa

Official website: https://courses.unige.it/11661

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antonio.camurri@unige.it
www.casapaganini.org
youtube.com/InfoMusLab

EU Horizon Europe ICT STARTS ReSilence: art-driven technologies for designing the soundscape of future cities targeting AI and XR. Interactive sonification of expressive movement qualities (https://resilence.eu) 2023-2025

EU H2020 FET PROACTIVE EnTimeMent (2019-2022): Multi timescale sensitive movement technologies. See https://entimement.dibris.unige.it and https://www.youtube.com/watch?v=o5Q0OHkDEe8

DanzArTe – Emotional Wellbeing Technology: pilot project commissioned by the Cultural Wellbeing Lab of the Compagnia di San Paolo bank foundation, 2021-2023 (www.casapaganini.org)