Absolute Relativity: A Multi-Agent Collaborative Performance Paradigm

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Absolute Relativity is a mapping concept with a distinct shift of approach: Where common performance instrument concepts map aspects of interface *state* to aspects of process state, we map *differences* in interface *state* onto *differences* in process state. This enables multiple sources to influence the same generative setup equally and simultaneously, by moving its configuration and its parameter states in desirable directions, thus making such setups natural multi-person instruments. We find this paradigm artistically promising, and currently explore it by leveraging our performance environment NTMI, where we already explored moving from control to influence for collections of multiple sound processes and interfaces, with adding such relative-influence modes at all levels for all interfaces and sources. Our current experimental setup includes human players using various interfaces supported by NTMI (our custom motion sensor/touch interface nUFO, gamepads and faderboxes); an 8-armed octopus-like sensor interface, the Kraken; phones sending xy-movements via a webpage; and finally as a non-human agent and live director, an experimental neuro-robotic pet, the flatcat. Informal participant and audience responses in the first public concert show have been very positive, and we have begun offering workshops to spread this approach further.

1. Introduction

Absolute Relativity is a concept that facilitates composing multi-person instruments, currently embodied in a concrete example implementation. More specifically, performers exert influence (de Campo 2014a, b) on the same set of processes simultaneously, and they focus on playing by intuition, intentionally foregoing fully detailed technical control. The current implementation of the concept rests on our long-term performance environment research project NTMI (Airborne Instruments, 2019a, b).

A first public performance on February 2, 2024 turned out very well: A quite complex setup contained two NTMI setups with multiple interfaces connected, and was activated by human players, and a non-human source of influence. The participating performers, reported enjoying performing with this approach. Interestingly, the performers were spontaneously joined by audience members who also wanted to play, and did.

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2. Background

Several earlier projects and works led us toward Absolute Relativity; as they also highlight different aspects of our approaches in development, we briefly describe them here.

2.1. NTMI performance environment

The core of the NTMI performance environment (Airborne Instruments, 2019a, b) consists of a collection of complex sound generating processes, bindings to a number of interfaces, using the SuperCollider library Modality (Modality 2014), and a special strategy for playing with several of these processes in parallel by influence instead of control, called Influx (de Campo 2014a, b).

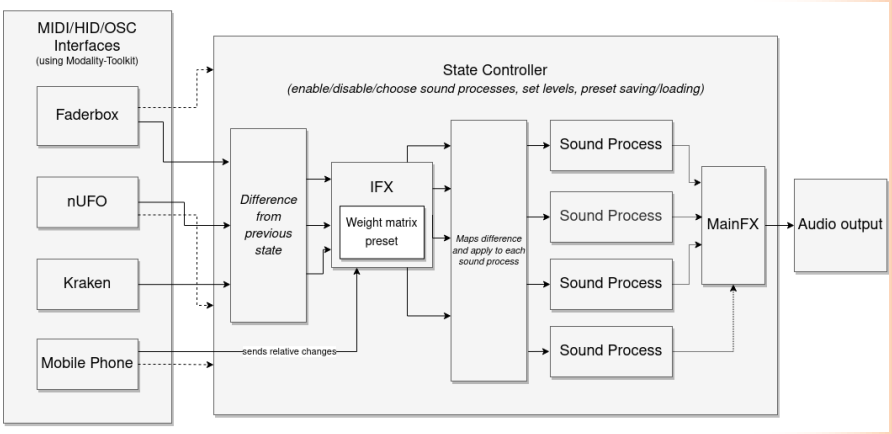


Fig. 1. NTMI environment topology, shown with absolute relativity mode

Briefly explained, each element of an interface, such as a slider or motion axis, is treated as an influence parameter whose current value difference is routed to an Influx input. The current Influx weight matrix holds a different set of random weights for each input, which is used to create a specific displacement vector for this input difference value. These vectors then displace the control parameters of currently active sound processes. For the performer, this means that even the simplest action (moving one slider) becomes a complex change in the generated sound; this encourages playing by listening, and exploring the possibility spaces of the sound processes becomes a central focus of this performance approach.

2.2. c0l1v3 collaborative live coding

c0l1v3 (Gola 2022-) is a collaborative live-coding platform. With its web-based non-linear text editor, multiple players connected via web browsers can edit multiple independent lines of code simultaneously to control the same underlying sound generating process. Virtual agents are also part of the system, using machine listening to decide when to intervene, navigating the possibility space in relative movements over some of the components of the sound processes. https://c0l1v3.bgo.la/

2.3 Neural Labyrinths

Neural Labyrinths (Neural Labyrinths team 2022) is inspired by the threads running through David Tudor's live electronics works, in particular, the balance between the deceptive technical simplicity of the configurations, and the subtle richness of their sounding behaviors. Much of the technical setup stems from Tudor's working methods: modular processing chains, tuned transducers, and people who "could only hope to influence" (Nakai 2021) the resulting generative system.

Neural Labyrinths is a network of usually six nodes/stations, each of which consists of:

an embedded computer running an audio feedback network loosely modeled on neural influence paths as a synthesis program; audio inputs to the feedback network from an air microphone, a vibration sensor, and two audio lines coming from other nodes; processing by a modular FX program as complex feedback/resonator; acoustic output via loudspeaker, and vibration transducer which activates a specially chosen resonator object; and two channels of audio output lines to feed into other nodes.

Each node/station is individualized by different choices of resonating objects, and transducers, and setup details. The overall assemblage of nodes is cross-connected by all acoustic signals traveling through air to all listening microphones and transducers, a fixed, hardwired topology of electronic audio connections, and their tunable connection strengths, in the form of audio input levels. This network is by design both an autonomous installation and a multi-player performance environment.

3. Absolute Relativity

Basic Influx

The underlying intention in Influx mode at the core of NTMI is to gracefully leave analytic control behind in favor of a very fast senso-motoric feedback loop: make a movement with/on the interface, listen to the change in the sound world, and learn to go with this flow of intuitive decisions by ear.

This was initially developed for a single performer and the special custom sensor/touch interface nUFO (Hoelzl et al 2019); later we added optional secondary interfaces like faderboxes, gamepads, and phones as motion sensors (see Fig. 1). Trying to play with those at the same time, while still in absolute mode, where controller state *sets* process state, posed interesting questions - the interfaces would overwrite each other's influences, causing jumps, unless one would add more and more independent Influx inputs.

Changing context & configuration

Due to the design of the nUFO interface, the configuration/context setup part of NTMI already used relative changes: instead of going to sound process 12 one would move within the list of sound processes by steps — up, down, by 1 or several steps — or random jump with equal chance for all sound processes. The same step logic applies for recalling stored parameter presets of individual sound processes, the available

Influx weight presets, and the main effects presets. This concept was also readily applicable to all alternative interfaces, such as faderboxes, gamepads, etc.

Relative Change of Parameters

In the Neural Labyrinths piece, the current absolute parameters of the sound processing are visible on and settable from a Raspberry touch screen. For installation mode, we devised a simple machine listener autopilot on each station which judges whether the sound should be louder, softer, or more varied, and increases the probability that all processing parameters will be nudged by a random relative change vector. This gave the installation enough agency to traverse large areas of its possibility space over time, always continuing from where the process was at the moment. (This led the main guard for the installation to report that he loved going there in the morning, because he was curious what the system would do today!)

How can a human player make performance decisions respecting this agency when playing at the same time as the autopilot?

On an interface that always syncs to the current parameter state, such as onscreen GUIs, or motorized physical faders, a human player always continues from the current state already. On non-syncing interfaces (or with multiple processes playing in parallel), this is where the idea of consistent relativity came in: every interface always already has a current physical state, and when you play, you create a new state with a clear difference to the earlier one; this difference can be translated into a difference in the process parameter state, using Influx matrix projection.

This setup invited the audience both to see the actual state of the paramters analytically, and to change the current settings with the interfaces in the installation setup. Giving the audience agency in this form seems quite promising for participatory installations — they become performance environments for multiple agents. This experience gave us the idea for absolute relativity.

Generalizing this idea of relative change to all the interfaces attached to one NTMI setup allowed playing with all of these at the same time, which turns it into an easily approachable shared-influence instrument. The next step we are currently exploring is connecting multiple nodes running individualised NTMI setups. Fig. 2 shows two approaches toward sharing influence vectors across NTMIs.

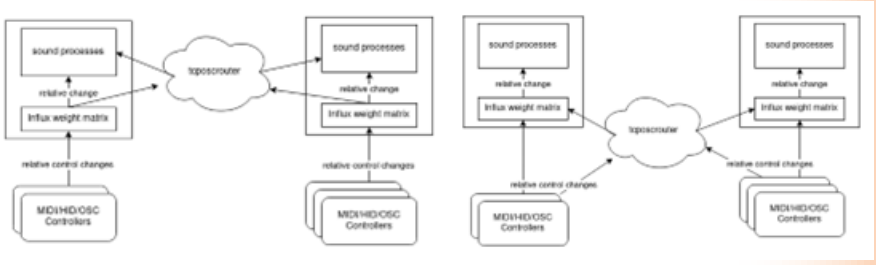
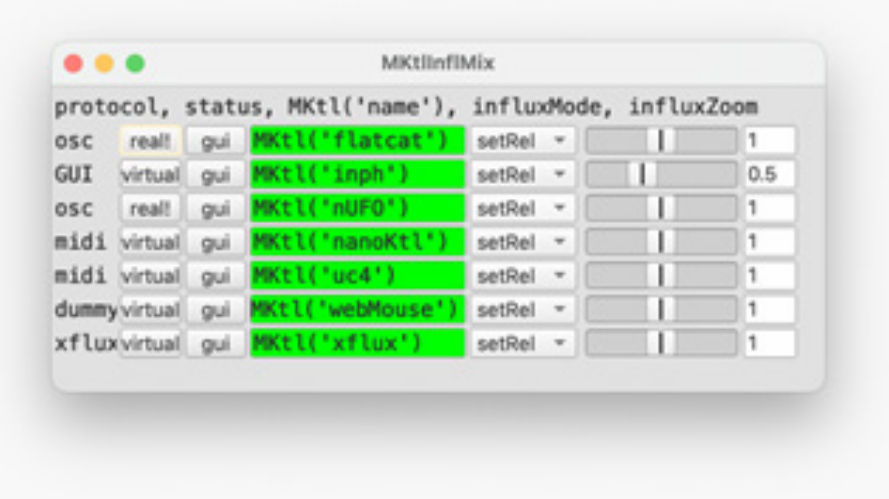


Fig. 2. Alternatives for sharing influence vectors: On the left, the influence matrix is considered part of the sender side, so the full difference vectors are sent; on the right, the difference values from the local interfaces are sent, so the influence matrix mechanism happens on the receiving side.

Finally, as in classical communication theory, the receiving side decides about the interpretation of the message, or here the influences: A little mixer panel (Fig. 3) lists all physically connected interfaces, such as HID gamepads (ferrari), MIDI faderboxes (nanoKtl, uc4), custom serial devices (kraken), OSC devices (flatcat, webmouse). The last entry,

xflux, is the pathway for all NTMI setups cross-influencing each other. For all sources, the amount of influence can be balanced continuously: all at equal level for full democracy, single sources can be turned higher, lower or fully off.

Fig. 3 Influence mixer panel



4. Multi-Agent Performance

The flatcat

In another context, we experimented with an experimental neurorobotic pet, the *flatcat* (Jetpack Cognition Lab), which aims to model animal-like reactions to being moved with simple but very effective strategies. We began using the NTMI as a sonification engine for its behavioral dynamics, translating its joint angles and motor forces into influences on the sound. Or if you look at it differently, this is enabling the non-human *flatcat* to play the NTMI by expressing its inner life through it. These experiments intensified the wish for relativity: if all influences are relative, then gentle, slow movements movements from a second source of influence can slowly shift which area of the possibility space of the current sound processes the flatcat movements are exploring.

The Kraken, a multi-person interface

A further source of inspiration is the Kraken, an experimental controller designed by Kuntay Seferoglu (an S4NTP member) for multi-person collaborative use. It has 8 wired arms, each of which ends in a 3D-printed shell which has a knob and touch button, and on some arms also a touch fader. This naturally suggests multiple players to perform with it, which reinforced the idea of playing simultaneously with an ensemble of multiple people on different interfaces.

NTMI & Relativity

Once the idea of relativity had crystallized sufficiently, applying the idea to the NTMI environment became straightforward: After some unifying code refactoring across the interface bindings, it only required imple-

menting a single relative change method that all supported interfaces use by default. One can still play them in absolute mode if so desired.

To understand the implications of this change in more depth, we next assembled an experimental setup with many kinds of available interfaces: the flatcat, the Kraken, the nUFO, two faderboxes, gamepads, and a custom webpage accessible via a smartphone browser which sends relative mouse XY data via an internet OSC router.

The full concert setup

The first public proof of concept by concert took place on Feb 2, 2024. The setup consisted of two laptops running NTMI, one with the kraken, the flatcat, and faderboxes, the other with the bCDE, faderboxes and gamepads. Furthermore, we applied the idea of giving signals to change to a non-human form of improvising ensemble direction:

When the flatcat's autonomous behavior produces large changes from one frame to the next, those would trigger changes in configuration (new sound processes, new presets, new main effects choices), and occasionally generate change instructions: a projected and speech-synthesized messages consisting of "Call for Change:" in one of the five languages spoken by the players, and a subset of the players' names.

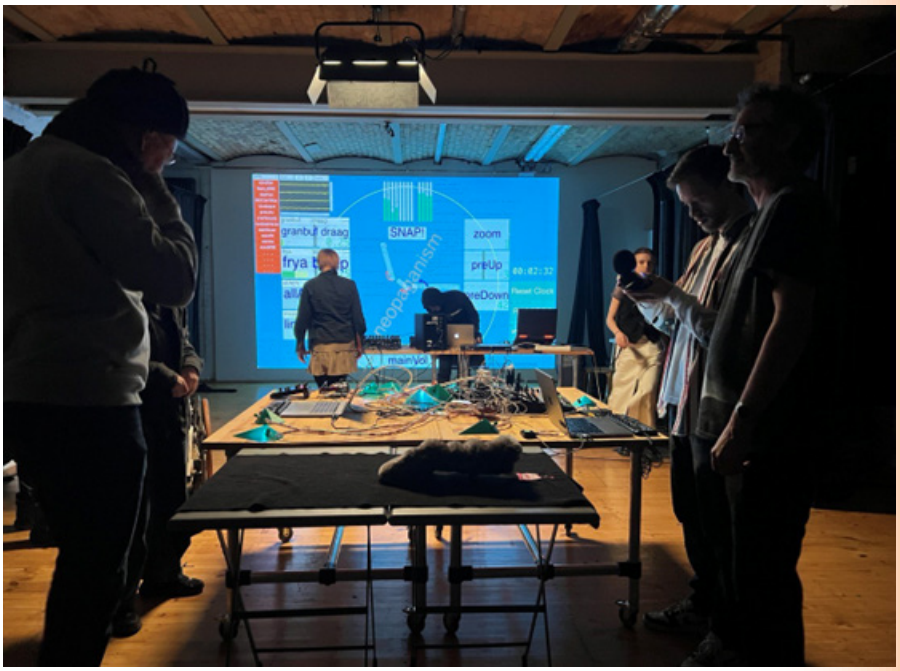


Fig. 4. Live concert setup, including the Flatcat (front table), Kraken (back table), MIDI faderboxes, gamepads; NTMI GUI is projected for better orientation of performers and audience.

This concert was very successful: The official participating performers (who were present in rehearsals and who are familiar with NTMI to varying degrees) expressed enjoying performing with this approach, and feeling as equal ensemble members. Interestingly, the performers were spontaneously joined by audience members who also wanted to play, and they did. As in the Neural Labyrinths piece described earlier, where we experienced a similar response, we consider this a very encouraging form of feedback.

Future concerts will include the bridges of influence between multiple NTMIs, the xy-sending mouse webpage, and other interfaces and sound processes participants are encouraged to bring.

5. Conclusions and Future Work

Reflecting on our experiences so far with this paradigm, we find that it opens the imagination for democratic forms of ensemble organization, as proposed in (Jorda 2005); the notional role of a composer here becomes designing the possibility space for the participating agents.

That audiences understand such systems as welcoming participation, and request to participate on their own initiative points to both an attraction to the playfulness of the approach, and to a sense of empowerment by joining the "official" performers. Loosening the barrier between the roles of performers and audience seems both artistically and socially desirable for us.

As an open source project based on SuperCollider, NTMI is open for many kinds of adaptations: choosing preferred sound processes, recording one's own preferred presets for them, adding self written bespoke sound processes; adding one's preferred interfaces to play (using MIDI, HID, OSC, Serial protocols), including ones designed to give people with special requirements equal access to this collaborative performance practice.

Thus, we invite and encourage NTMI users to contribute some of their personal sound processes and interface bindings to the NTMI codebase, and thus increase the social and artistic possibility space of this paradigm.

Finally, we hope the Absolute Relativity concept can bring interesting shifts of perspective in a wide variety of performance projects, and we are looking forward to learn about them.

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Ethical standards: No Krakens, flatcats or other human and non-human beings were hurt in the research, experiment and performance processes within this project.

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Appendix

More sound/video examples of performances and experiments available at:
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