



## TuringGaia: Composing the ((Non)Human)



### **Martinus Suijkerbuijk**

[martinus.suijkerbuijk@ntnu.no](mailto:martinus.suijkerbuijk@ntnu.no)

Norwegian University of Science and  
Technology (NTNU), Trondheim, Norway

### **Øystein Fjeldbo**

[oystein.fjeldbo@ntnu.no](mailto:oystein.fjeldbo@ntnu.no)

Norwegian University of Science and  
Technology (NTNU), Trondheim, Norway

*TuringGaia: Composing the ((Non)Human)* is an audio-visual performance that explores ((Non)Human) agency through an AI-driven NPC within a virtual ecosystem. Central to this exploration is NPC-Markov, equipped with an advanced cognitive architecture that intertwines algorithmic interactions with environmental affordances, creating a complex audio-visual narrative on artificial agency and environmental engagement. The performance connects to an NPC in a Gaming Engine (UE5). The NPC operates in a zero-player game as entropy mitigator of a virtual world under siege of a chaotic climate, offering a metaphorical take on survival tactics amidst the climate crisis, highlighting themes of adaptation and resilience. A Large Language Model (Inworld), acting as a meta-narrator, deepens this narrative, expressing NPC-Markov's explorations and reflections through a synthetic voice (Elevenlabs). By blending the footage generated by NPC-Markov with advanced audio techniques, *Composing the ((Non)Human)* crafts a dynamic narrative that evolves in real-time, showcasing the fusion of digital storytelling, gaming environments and soundscapes.

**Keywords** Cyber-Physical Ecosystem,  
Computational Aesthetics, LLM, NPC,  
Cognitive Architecture.

**DOI** [10.34626/2024\\_xcoax\\_042](https://doi.org/10.34626/2024_xcoax_042)

## Description

*TuringGaia: Composing the ((Non)Human)* is part of the umbrella research project TuringGaia | Entering ThermoDome on display during Meta.Morf 2024 (NO). The research project investigates the intricacies of how an autonomous non-playable character (NPC) embedded in a virtual ecological zero-player game can narrate and communicate its environmental journey and internal ‘experience’. The long-term installation serves as a sandbox, where every day NPC-Markov faces not only a different climate, it also collects data, such as pixel-based entropy, temperature, color variation, location-based events, perceived objects, etc.

The title *TuringGaia*, refers to an increasingly developing scenario where the biosphere and technosphere have reached a profound state of symbiotic interdependence. In this scenario the technosphere, or The Stack (Bratton 2016) contributes to Earth’s self-regulation alongside the biosphere. This integration fosters possibly a heightened planetary awareness, presenting both ecological challenges and opportunities as humanity plays a central role in shaping the coevolution of biology and technology on our planet. The ((Non)Human) encapsulated by its double parentheses, functions as the new subject of this new hyperconnected constellation, which ultimately provokes us to rethink an obsolete notion of Nature (Latour 2017).

*Composing the ((Non)Human)* unfolds as the live demonstration of TuringGaia as a Cyber Physical Ecosystem (Friston et al. 2022), where humans and AI interact to facilitate a ‘shared intelligence’, and in our case exploring the artistic limits of ((Non)Human) agency. The performance carefully navigates the boundaries between human and non-human elements through AI, sound, and image. Central to this exploration is NPC-Markov, an advanced cognitive architecture equipped with a distinctive sensory suite. The base architecture consists of a range of finite state machines inspired on the subsumption architecture (Brooks 1986). These are behavioral based states and diverge from exploring, interaction, exploitation, focus, manipulation, etc.

Positioned within a carefully designed virtual realm, NPC-Markov’s interactions are influenced by a dual approach: on one hand, they are shaped by procedural algorithms, memory processes, and environmental inputs; on the other, they are delicately guided and adjusted through the parametric manipulation of external variables. This dual approach facilitates a refined engagement with and modulation of NPC-Markov’s behavior, enriching the resultant audio-visual composition.

Equipped with sensors, sensitively calibrated to measure digital entropy, and thermal variations, NPC-Markov harnesses environmental heat as a pivotal element in crafting the live performance. This sensitivity plays a pivotal role in the live composition process, where heat — as an experimental narrative and auditory guide — is harnessed from the environment. This innovative approach not only allows for dynamic responses to subtle thermal changes but also metaphorically explores survival strategies in an era of climate crisis, presenting a thought-provoking commentary on adaptation and resilience. However, this introduces a challenge: how can we make NPC-Markov’s experiential world not just perceptible but also meaningful and relatable to a human audience?

To explore this question further, the creators employ a Large Language Model (Inworld) as an interface for ((Non)Human) interaction. Inworld serves a dual purpose: it acts as a meta-narrator –expressed as a synthetic voice– articulating NPC-Markov’s environmental explorations, and it also offers introspective reflections on NPC-Markov’s internal states, which are informed by the NPC’s cognitive architecture. This is by no means aimed at further mystifying the computational processes, but rather seeks to cultivate a creative dialogue with NPCs as an emerging class of Autonomous Language Agents (Weng 2023; Wang 2023). Additionally, Large Language Models (LLMs) are proposed as tools for enhancing a general game sense for promising actions conditioned on game history (Yao 2020). This methodology enables the NPC to more effectively engage with its surroundings, thus facilitating a deeper investigation into the capabilities and potential of LLMs as interfacing ((Non)Human) experience.

The performance and its technical back-end emerge as extension of Cybertext (Aarseth 1998), crafting a story that speaks to the resilience and adaptability inherent in life. Within this digital ecosystem, NPC-Markov adjusts to shifting climatic conditions against a backdrop of unpredictable weather phenomena, ecological uncertainties and surprising flora and fauna. This virtual setting acts not only as a narrative canvas but also as an aesthetic document to survival, offering a rich and imaginative examination of a world in active dialogue with the impacts of climate change.

Integrating live interaction with the NPC, the performance invites NPC-Markov on an autonomous voyage through a complex digital realm that unfolds in real-time. This approach engenders an organic narrative and a cohesive composition that evolve based on the game’s decision-making processes. Such interactivity adds a compelling layer of complexity, with each decision subtly influencing the narrative’s progression and the soundscape’s evolution. This dynamic interplay exemplifies the potential of algorithmic composition to elevate sound beyond a supportive role, transforming it into an essential, interactive component of the story.

The creators assume the role of dynamic live orchestrators, shaping the environment visually and sonically, where digital and live performance seamlessly converge. In this liminal space, the NPC reacts in real-time to human performance. Meanwhile, the human performers attune to and interact with the NPC’s ‘experiences’, fostering a reciprocal feedback loop of the ((Non)Human). The performance fluidly alternates between spontaneously generated content and structured compositions, constantly wavering between a quasi-theatrical presentation and an immersive live concert.

The composition integrates two key tools, blending real-time and pre-processed elements. It employs the Ircam Acids Real-time Audio Variational Autoencoder (RAVE) (Cailon and Esling 2021) to link live audio with vast sound databases through timbral and temporal similarities, tapping into a deep reservoir of abstract sound memories. Additionally, it utilizes the University of Huddersfield’s Fluid Corpus Manipulation (FluCoMa) toolkit (Tremblay, Roma and Green 2022) for breaking down and speculatively separating sonic elements. This approach fosters a synthetic form of listening, marked by artifacts and misinterpretations, producing a stream of evolving sound objects that

mimic continuous cognitive associations between the external and internal realms. Together, these tools not only enhance the composition's auditory depth but also underscore the intricate relationship between pre-processed and live elements, all while maintaining a seamless integration with the overarching themes of the ((Non)Human) and its (techno) umwelt (Uexküll 2013).

## References

### Aarseth, Espen.

1997. *Cybertext: Perspectives on Ergodic Literature*. Baltimore, ML: JHU Press.

### Bratton, Benjamin.

2016, *The Stack: Software and Sovereignty*, Cambridge, the MIT Press.

### Brooks, Rodney.

1986. "A robust layered control system for a mobile robot". *IEEE Journal of Robotics and Automation*. 2 (1): 14–23. [doi:10.1109/JRA.1986.1087032](https://doi.org/10.1109/JRA.1986.1087032). [hdl:1721.1/6432](https://nbn-resolving.org/urn:nbn:de:hbz:5:1-6432-p0011-7). [S2CID 10542804](https://www.scribd.com/document/10542804)

### Friston, Karl J., Maxwell J.D. Ramstead, Alex B. Kiefer, Alexander Tschantz, Christopher L. Buckley, Mahault Albarracin, Riddhi J. Pitliya, et al.

2024. "Designing Ecosystems of Intelligence from First Principles." *Collective Intelligence*, 3(1).

### Latour, Bruno.

2017, *Facing Gaia, Eight Lectures on the New Climate Regime*, Cambridge, Polity Press.

### Rees, Tobias.

2022 "Non-Human Words: On GPT-3 as a Philosophical Laboratory." *Daedalus* 151, no. 2 (2022): 168–182. MIT Press Direct, [https://doi.org/10.1162/daed\\_a\\_01908](https://doi.org/10.1162/daed_a_01908).

### Wang, Lei, Chen Ma, Xueyang Feng, Zeyu Zhang, Hao Yang, et al.

2023. "A Survey on Large Language Model Based Autonomous Agents." Presented at the Conference on Neural Information Processing Systems (NeurIPS).

### Weng, Lilian.

2023, "LLM-Powered Autonomous Agents." <https://lilianweng.github.io/posts/2023-06-23-agent/>

### Yao, Yao, Rohan Rao, Matthew Hausknecht and Karthik Narasimhan.

2020. "Keep CALM and explore: Language models for action generation in text-based games". arXiv preprint arXiv:2010.02903, 2020. <https://doi.org/10.48550/arXiv.2010.02903>

### Tremblay, Pierre Alexandre, Gerard Roma and Owen Green.

2022. "Enabling Programmatic Data Mining as Musicking: The Fluid Corpus Manipulation Toolkit." *Computer Music Journal* 2022; 45 (2): 9–23. [doi: /10.1162/comj\\_a\\_00600](https://doi.org/10.1162/comj_a_00600)

### Uexküll, Jakob von.

2013. *A Foray into the Worlds of Animals and Humans: With A Theory of Meaning*. Minneapolis, University of Minnesota Press.