

# Synthetic Pulsar (Speculative Sonification)

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*Synthetic Pulsar (Speculative Sonification)* looks at the pulsar as a dazzling multi-dimensional object of scientific and creative focus. While the pulsar traverses a wide range of disciplines – astrophysics, radio technique, and sound technology – the workings and nature of such an object can never be fully captured, hence remaining incompletely understood. Proposed work probes this complexity through a process of speculative data sonification: amplifying, modulating and augmenting astrophysical data - sourced from the European Pulsar Network - within an original implementation of pulsar synthesis program (nuPG) designed by the author.

**Keywords** sonification,  
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modelling, pulsar  
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## Background

1. Gérard Grisey incorporated recordings of incorporated the signal of pulsars Vela and PS 0359-54 as integral elements of the composition *Le Noir De L'Etoile* written for percussion ensemble Les Percussions de Strasbourg. In two sections of the composition (22'07- 24'53 and 35'53-37'59) a recording of pulsars' signals as detected by radio telescope Nancay was played back over an array of 12 loudspeakers distributed around the audience. At the premiere of the work in 1992, an initial idea to stream live pulsars' signal from Nancay observatory to the concert hall in Brussels was not feasible technically. Thus, the recording was used instead.

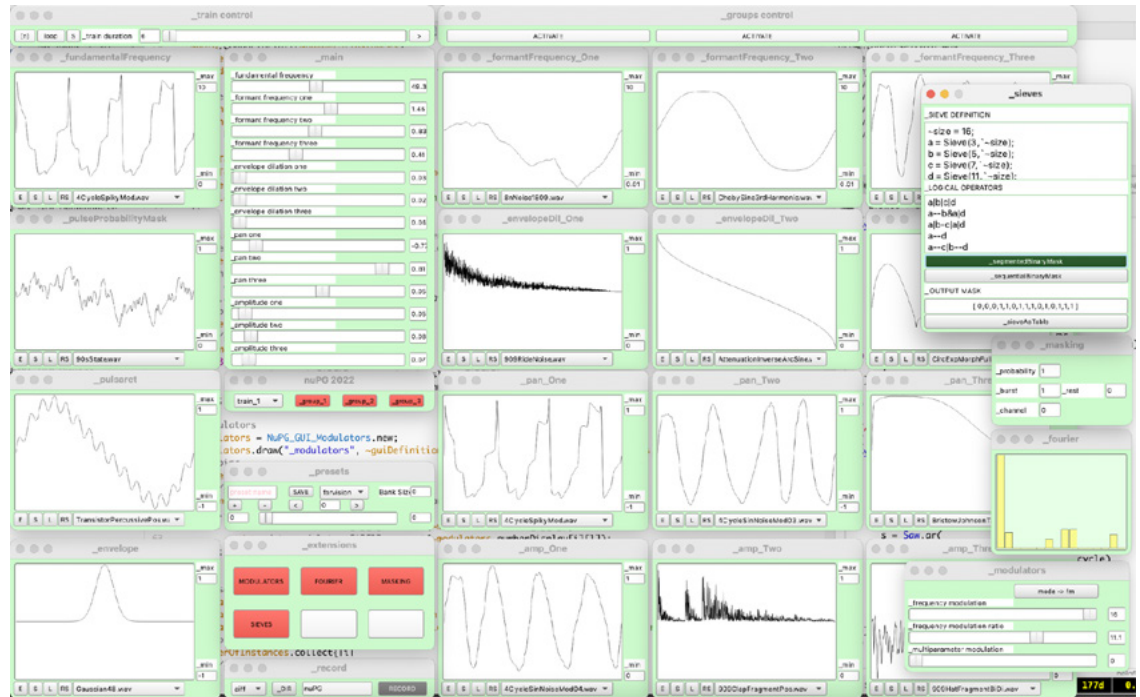
2. The system used in the work is based on RedUniverse Quark for SuperCollider developed by Mark d'Inverno and Fredrik Olofsson: <https://fredrikolofsson.com/f0blog/work-with-mark-reduniverse-a-simple-toolkit/>

The sonification of pulsars at first sight seems paradoxical. The pulsar data in one of its raw formats consist of a radio signal which is already audible<sup>1</sup>. The data can also come in a numerical format representing rotational profile of observed pulsars. Within such a format pulsar rotation is sampled at a given interval and its data can be represented as a 2-dimensional set of values. An integration of data from astrophysical pulsars into compositional work with the New Pulsar Generator (nuPG) program resonates closely with an approach of augmented sonification where an auditory stream becomes modulated by an additional process or data. Such a process is a key method in the composition *Synthetic Pulsar (Speculative Sonification)* (2021). The work was commissioned by CTM Festival Berlin and Deutschlandradio Kultur, and originally presented as a sound installation spatialized on an specially built array of 64-channel soundsystem at Vollgutlager in Berlin. The original version of the work included a collaboration with a singer Alex Freiheit and Birds on Mars a collective specialising in synthetic voice design. A binaural version of the work was streamed by Deutschlandradio Kultur as part of their Klangkunst series: <https://www.hoerspielundfeature.de/hoerstuecke-mit-kuenstlichen-stimmen-ventrilogues-1-100.html>. The version of the work presented at the XCoAx does not include the libretto and the synthetic voice, the aim is to highlight the relationship between the formal development of the composition and the model of augmented sonification.

The work *Synthetic Pulsar (Speculative Sonification)* invites listeners to explore a dynamic system in action. Processes of attraction and repulsion are modelled within a digital model of a world with its own size, dimensions and gravity, providing a basis for hybrid sonification approaches<sup>2</sup>. The material point of departure for the work is a new implementation of the pulsar synthesis technique in the form of The New Pulsar Generator (nuPG) program designed and programmed in SuperCollider 3 programming language (Fig 1). The technique of pulsar synthesis is named after the spinning neutron stars that emit periodic signals in the range of 0.25 Hz to 642 Hz. The range of frequencies—between pulse and continuous tone—is of central importance in pulsar synthesis. The pulsar as a technological device refers to a sound synthesis technique originally invented by Curtis Roads (Roads, 2001) and implemented as a standalone PulsarGenerator program together with Alberto de Campo (2001). The technique of pulsar synthesis offers a seamless link between musical time-scales of individual particle rhythms, periodic pitches, and the meso-temporal or phrase level of composition. Pulsar micro-events produce rhythmic sequences or, when the density of events is sufficiently high, sustained tones, allowing composition to pass directly from micro to meso-temporal domain. As an audio technique, the origins of pulsar synthesis can be traced to historical analog techniques built around a principle of filtered pulses. The voice-like characteristics of its timbre can be linked with early experiments in speech synthesis at

the Westdeutscher Rundfunk (WDR) in Cologne by Werner Meyer-Eppler, Herbert Eimert and Robert Beyer.

**Fig. 1.** The New Pulsar Generator (nuPG) program designed in SuperCollider 3 programming language. The program incorporates graphical modes of interface as well as text-based (live coding) extension allowing experimentation with algorithmic processes and flexible mapping between data and synthesis.



The astrophysical pulsars are phenomenal objects: rapidly rotating neutron stars that send out beams of radio waves which, like lighthouse beams, sweep around the sky as the star rotates. They are amazingly precise timing devices that can be used as clocks for testing relativity theory and may be used for timekeeping and navigation. With a diameter of only about 15 kilometres and a density comparable to that of the nucleus of an atom, they also provide a laboratory for some extreme physics. Pulsars appear to ‘pulse’ since the beam of light they emit can only be seen when it faces the Earth. The discovery of pulsars by Jocelyn Bell Burnell is considered to be one of the greatest astronomical discoveries of the twentieth century.

In the staging of the work, the listener is invited to explore spatially distributed formations of sound clusters, discrete pulses, tones and textures sonifying processes of attractions and repulsions. The word ‘speculative’ in the title signifies a double position. First, the combination of the data (pulsar rotation profiles) with the attraction-repulsion model is conjectural rather than relational in regard to observed and measured phenomena. Second, by sonifying “impossible” objects and their behaviour the work mobilised the ways intuition and bodily (spatial) experience take an integral part in formation of our worldly *episteme*. Knowledge does not restrict its corpus to the sum total of perfectly certain propositions but includes conjectures, articulations of possibilities and experimental settings.

## References

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