Dynamical Systems in Interaction Design for Improvisation

Tom Mudd
Music Computing Lab, Centre for Research in Computing
The Open University
Milton Keynes, UK
tom.mudd@open.ac.uk

Dr Nick Dalton
Music Computing Lab, Centre for Research in Computing
The Open University
Milton Keynes, UK
nick.dalton@open.ac.uk

Dr Simon Holland
Music Computing Lab, Centre for Research in Computing
The Open University
Milton Keynes, UK
simon.holland@open.ac.uk

Dr Paul Mulholland
Music Computing Lab, Centre for Research in Computing
The Open University
Milton Keynes, UK
paul.mulholland@open.ac.uk

Abstract

This paper proposes the use of, and investigation of the value of, nonlinear dynamical elements in mappings between human input and system output in interactive systems. Motivation for this, and a case study, are drawn from the practices of free, aural improvisers in digital and acoustic music. Nonlinear dynamical systems in existing sound creation mechanisms help create the rich affordances of many acoustic instruments, notably reed instruments. Dynamical systems also play a key role in electronic instruments, with many performers placing the exploration of feedback processes at the centre of their practice. We propose that the use of nonlinear dynamical elements can be usefully moved up from output mechanisms and incorporated explicitly at a higher level in the mappings between human input and system output in digital music systems. However, digital music is not the only area of human activity where divergent, open-ended, exploratory thinking is valued. We thus propose the incorporation of, and investigation of the value of, nonlinear dynamical elements in mappings between input and output in interactive systems more generally, in particular when designing for domains where divergent problem solving and problem seeking play an important role.

Author Keywords
Free Improvisation, Nonlinear Dynamical Systems, Mapping, Affordance

ACM Classification Keywords
J.5 [Arts and Humanities]: Music, Performing Arts; H.5.2 [User Interfaces]: Interaction Styles; Theory and methods

Introduction
The acceptance that ideas are formed through an engagement with tools [6, 4], and the recognition that the instrument is not a transparent medium through which ideas are transmitted unmediated, are deeply embedded in many contemporary approaches to music, both electronic and acoustic [5, 16, 7]. Free improvisation in particular can demonstrate an interesting perspective on the relationship between humans, tools and creativity due to the emphasis placed on searching and exploration (notably those involved in improvising group AMM [3] and Prévost's improvisation workshops [11]). In such circumstances, the tool is not a means to achieve a fixed end, but something that is actively investigated by the musician during a performance. The requirements that a musician will have of their instrument can therefore be very different from everyday tools and even from musical instruments in less exploratory contexts. Any method of eliciting sound from the instrument is as valid as any other, just as any sound is as potentially valid as any other. Many free improvisers embrace chaotic or unstable elements in their instruments, whether electronic or acoustic. Saxophonist John Butcher has said of his practice that "a lot of the material I work with is right at the border of the instrument - the reed - seizing up and breaking down. It's on the edge of controllable sound." [15]. Similar attitudes can be traced in electronic musicians utilising feedback in improvisation [13, 14].

Dynamical Systems in Interaction Design
Human interactions with nonlinear dynamical systems have come under increasing scrutiny [8], but the very properties and behaviours that make them difficult to manage in many other interaction design contexts appear to appeal strongly to musicians working in free improvisation, where the instrumental system can often be viewed more as a collaborator than a passive transmitter [1, 2]. Studies conducted by several researchers [9, 12, 10] claim that increased complexity in the control of digital musical devices can lead to a change in engagement towards a more holistic view of the instrument. In the case of authors [9] and [12], such complexity is afforded by the use of many-to-many mappings between input parameters and sound parameters. By contrast designer-practitioner [10] achieves complexity through the deliberate inclusion of linear dynamical processes. Multi-variable dynamical systems (such as Lorenz systems) inherently include many-to-many mappings as their state variables are dependent on each other, and any change in one has an effect on the others. The various inputs and outputs are thus bound into a whole, just as they are in many acoustic instruments. The deliberate inclusion of nonlinearities in the interaction design can be seen as a novel design strategy to create a rich landscape of affordances that invites exploration and experimentation. Such landscapes have recognised value in free improvisation where exploring landscapes of affordances plays a key role in the activity of improvising. We posit that dynamical systems may be similarly employed in interaction designs for domains beyond music that also reward divergent approaches to a given task. Computer games provide relevant examples, particularly physics based games where creativity is encouraged.[1]

[1] Max Dirt Bike provides a very straightforward example, available at http://maxdirtbike.org

References

[1] Bailey, D. *Improvisation: Its Nature and Practice in Music*. NY: Da Capo Press, 1992.

[2] Borgo, D. *Sync or Swarm: Improvising Music in a Complex Age*. Continuum International Publishing Group Inc, 2007.

[3] Cardew, C. Towards an ethic of improvisation, 1971. In Treatise Handbook. London: Edition Peters.

[4] Collins, N. Composers inside electronics: Music after David Tudor. *Leonardo Music Journal 14* (2004), 1–4.

[5] Cox, C., and Warner, D. *Audio Culture, Readings in Modern Music*. Continuum, New York/London, 2009.

[6] Di Scipio, A. 'sound is the interface': from interactive to ecosystemic signal processing. *Organised Sound 8*, 3 (2003), 269–277.

[7] Fell, M. Collateral damage. *The Wire Magazine, January 2013* (2013).

[8] Funke, J. Dynamic systems as tools for analysing human judgement. *Thinking and Reasoning 7*, 1 (2001), 69–89.

[9] Hunt, A., and Kirk, R. Mapping strategies for musical performance. In *Trends in Gestural Control of Music*, M. Wanderley and e. M. Battier, Eds. Ircam - Centre Pompidou, 2000, 231–258.

[10] Menzies, D. Composing instrument control dynamics. *Organised Sound 7*, 3 (2002), 255–266.

[11] Prévost, E. *The First Concert: an adaptive appraisal of a meta music*. Copula - an imprint of Matchless Recordings and Publishing, 2011.

[12] Rovan, J., Wanderley, M., Dubnov, S., and Depalle, P. Instrumental gestural mapping strategies as expressivity determinants in computer music performance. In *Proceedings of the Kansei Workshop* (1997), 68–73. Genoa: Associazione di Informatica Musicale Italiana.

[13] Sanfilippo, D., and Valle, A. Towards a typology of feedback systems. In *Proceedings of the International Computer Music Conference* (2012), 30–37.

[14] Soundhub, 2013. Broadcast on 23rd July 2013. Available at: http://soundcloud.com/resonance-fm/21-30-00-soundhub-256kbps-19.

[15] Warbuton, D. John Butcher interview, 2001. Paris Transatlantic, March 2001, available at: www.paristransatlantic.com/magazine/interviews/butcher.html.

[16] Worth, P. *Technology and ontology in electronic music: Mego 1994-present*. PhD thesis, The University of York, Music Research Centre, 2011.