Introduction to "Black Hole Tech?"

Todd Rowland
Wolfram Research, Inc.
100 Trade Center Drive
Champaign, IL 61821
rowland@wolfram.com

This short article is an introduction to the republication of "Black Hole Tech?" for the audience of *Complex Systems*.

The following is a republication of a blog post [1] that Stephen Wolfram wrote on February 22, 2016. He asks the basic question, what can we do with black holes? Imagine that we had one, or many. There are many analogies to complex systems, for example, the well-studied cases of the single recurrent neuron [2] or the large-scale cellular automata fluids [3].

Because of the blog format, there are a few things that would not normally appear in an academic paper. For example, it refers to the LIGO announcement of gravitational waves [4] as happening "last week," and instead of live animations, the print version is static and the online version has external links. Also, there are some things missing, like explaining how black holes can be treated as a rule system like those found in his book *A New Kind of Science* [5] or referencing past (and contemporary) work like periodic configurations for the *n*-body problem [6–11]. One obvious suggestion for future work is to combine those more fully, for example, by searching for gravitational configurations that are not periodic but admit a simple explanation, such as a substitution system.

But the main takeaway is probably insight into how to turn a complex system like black holes, with decades of abstract academic research, into something technological, something useful.

References

[1] S. Wolfram, "Black Hole Tech?," from *Stephen Wolfram Blog*—A Wolfram Web Resource. (Nov 9, 2016) http://blog.stephenwolfram.com/2016/02/black-hole-tech.

[2] R. Ndoundam, "Period-Halving Bifurcation of a Neuronal Recurrence Equation," *Complex Systems*, **20**(4), 2012 pp. 325–349. http://www.complex-systems.com/pdf/20-4-3.pdf.

https://doi.org/10.25088/ComplexSystems.25.4.255

[3] S. Wolfram, 1986. "Cellular Automaton Fluids 1: Basic Theory," *Journal of Statistical Physics*, **45**(3–4), 1986 pp. 471–526. doi:10.1007/BF01021083.

[4] B. P. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration), "Observation of Gravitational Waves from a Binary Black Hole Merger," *Physical Review Letters*, **116**, 2016 061102. doi:10.1103/PhysRevLett.116.061102.

[5] S. Wolfram, *A New Kind of Science*, Champaign, IL: Wolfram Media, Inc., 2002.

[6] C. Moore, "Braids in Classical Dynamics," *Physical Review Letters*, **70**(24), 1993 pp. 3675–3679. doi:10.1103/PhysRevLett.70.3675.

[7] C. Simó, "New Families of Solutions in *N*-body Problems," *European Congress of Mathematics: Barcelona, July 10–14, 2000, Volume I* (C. Casacuberta, R. M. Miró-Roig, J. Verdera and S. Xambó-Descamps, eds.), Basel: Birkhäuser, 2001 pp. 101–115. doi:10.1007/978-3-0348-8268-2_ 6.

[8] R. J. Vanderbei, "New Orbits for the *n*-Body Problem," *Annals of the New York Academy of Sciences*, **1017**(1), 2004 pp. 422–433. doi:10.1196/annals.1311.024.

[9] G. T. Minton, "Rigorous Numerical Methods for Gravitational Orbits," presentation given at *2013 Joint Mathematics Meetings*, San Diego, CA. (Nov 9, 2016) http://jointmathematicsmeetings.org/meetings/national/jmm2013/2141_program _saturday.html.

[10] M. Trott, "What Do Gravitational Crystals Really Look (i.e. Move) Like?," from *Wolfram Blog*—A Wolfram Web Resource. (Nov 7, 2016) http://blog.wolfram.com/2016/06/02/what-do-gravitational-crystals-really-look-i-e-move-like.

[11] G. Minton. "choreo.2.3.js." (Nov 7, 2016) https://gminton.org/choreo.html.

https://doi.org/10.25088/ComplexSystems.25.4.255