Computing with irrational 3-speed signal machines

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Abstract. In signal machines, signals/line segments are extended until they meet, then they are replaces by new signals according to some collision/rewriting rules. Speed of the signals corresponds to the slopes of the segments.
It is easy to build a Turing-universal signal machine with any four different speeds and impossible with two (or less). The three speed case is twofold: restricting speeds and initial positions to rational numbers leads to periodic behavior whereas a simulation of Turing machine was built-up with an irrational position [Durand-Lose, 2013]. Basically, it the rational case, the space-time diagram is entangled into a regular mesh that bounds the memory available to compute. Otherwise, with a clever use of the golden ration, a fractal can be generated. By controlling the fractal generation, it is possible to generate extra tape cell on request indefinitely.
In this informal presentation, generic signal machine and signals for an initial configuration are provided so that they ensure the simulation of a Turing machine as soon as provided speeds or initial positions exhibits some irrational ratio. First a scheme to enlarge the tape indefinitely is presented. Then, by a case study, it is shown how to always generate it.

Key-words. Computability; Signal machine; Turing universality; Unconventional computation.

Bibliography

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