Motivation for our algorithm for the Fake Life Recognition Contest

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Our inspiration for the algorithm is based on an article by Froese and Taguchi (2019), in which they emphasize that real living systems exhibit self-organization of order, but they do so in a way that is continually surprising. More specifically, they are not only chaotic, but also nondeterminate dynamical systems. We expect that these are essential properties that are distributed over behaviors in a scale-free manner, similar to the Lévy search patterns found in many biological systems (e.g. Viswanathan et al., 1996).

We tested our expectation by making a histogram of inter-event intervals, where an event is defined to be a sufficiently large change in orientation, and then fitted a power law function to the distribution. All of the exponents of the power laws were roughly in the range of 1 and 2, which is a general marker of 1/f noise, and hence on this coarse-grained view all trajectories were somewhat consistent with biological movement (Ward & Greenwood, 2007). Accordingly, we decided that the exponents of the power laws in themselves provided an insufficient basis to make the discrimination between real and artificial life.

We therefore decided to base the discrimination on how well the power law fit the interevent interval distribution. Our reasoning was that we should be able to approximate the movement patterns of a real living system with a power law, but neither too much (which would indicate an idealization, hence a computerized function) nor too little (which would indicate a lack of 1/f noise, hence no regular scale-free organization).

The final decision regarding the cut-off values to be applied to the reduced Chi-squared statistic were arbitrary, but we were guided by the principle that we should expect a difference in orders of magnitude. More specifically, based on a visual inspection of the spread of reduced Chi-squared values, we decided that if the power law fitted to the inter-event interval distribution of a given trajectory turns out to have a reduced Chi-squared value of less than 10 or more than 100, then we designate that trajectory as produced by an artificial life system.

References

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