The OEE measure - will it blend?

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1 minute about each:

1. Motivation
2. Design
3. Application 1
4. Application 2
5. Conclusions
Motivation
Explaining the analogy

https://www.youtube.com/watch?v=5MMmLQ1rBws
measuring activity in ALife systems is like blending consumer electronics.

Yes – you get a comparison, but the comparison isn’t telling you what you want to know.

Need this be the case?

Is this an area we should be working on?
Reason 1: Finding key events

- In chemical systems, it is sometimes impossible to figure out what’s going on.
- Not so in software systems – here the problem is handling ‘complete knowledge’
- Particularly so with large-scale simulations
- An EA measure should help us to detect these things
Reason 2: Comparing Designs

- We start from scratch too often in ALife
- We don’t compare systems rigorously
- We can’t improve systems without measuring them
- All of these arguments require a measure.
Design
We want a *numeric* measure – not simply graphical

Based *solely* on population data – which will then be widely applicable

We don’t want to distinguish between intrinsic or extrinsic fitness
Evolutionary Activity measure

We need to measure the activity of the system. We use the QNN measure, which we’ve used to analyse mutation rates in tierra previously:

The activity of species \( i \) at timestep \( t \) is:

\[
a^i_t = \begin{cases} 
(p^i_t - e^i_t)^2 & \text{if } e^i_t < p^i_t \\
0 & \text{otherwise}
\end{cases}
\]

The total non-neutral activity \( A_Q \) of the simulation is the sum of each species activity at each timestep:

\[
A_Q = \sum_{i} \sum_{t=0}^{T} a^i_t
\]
Example I: Tierra
Debiasing Tierra

Tierra is an *emulation* of life – not a *simulation*.

Biases are features that influence the evolution of the system in ‘unplanned’ ways:

- **Reaper bias**: ‘double hit’ for ‘correct’ behaviour
- **Substitution bias**: ‘guided mutation’
- **Length bias**: ‘tuned mutation’
- **Zero-address bias**: ‘undocumented niche’
QNN Activity values for 100 trials per two configurations:

(Note the different scaling of the y-axis)
Example II: Stringmol
Conservation of Matter in AutChems

- **Fixed**: equal ‘concentrations’ of each opcode
- **Fittest**: evolved, variable concentrations of each opcode
- **Boosted**: As fittest, but with increased concs. of the scarce opcodes

![Box plots comparing QNN for fixed, fittest, and boosted conditions.](chart.png)
Conclusion
Conclusion

- QNN is a useful measure for comparing systems and improving designs
- Useful for finding examples of ‘activity’ in large datasets
- Should not be used in isolation – we need more measures – OEE is multi-objective
- The potential to be used as a ‘meta-evolver’ for OEE
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