The Liquid State Machine is Not Robust to Problems in its Components

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The Liquid State Machine has been proposed by Maass and others as a computational framework for brain function that focuses on reverberating temporal activity as opposed to attractors.

First, we show that the Liquid State Machine in its basic approach cannot serve as a natural model for brain function. This is because they are very vulnerable to failures in parts of the model. Thus, for example, a small number of neurons that respond differently than they did during learning (e.g. a substantially different threshold) causes the activity pattern of the liquid to change so much that it can no longer identify trained signals. This result is in contrast to the work by Maass and others which showed that these models are robust to noise in the input data.

Second, we show that, on the other hand, if the LSM , while retaining a random connectivity, nonetheless has certain internal topological structures related to "hubs" or "small world topology", it can then perform reliably even under conditions of damage. Since it has been argued in other works that these topologies arise naturally, this modified version can then be considered as a possible model.