An Electrochemical Reaction Reservoir Computing realized by Multiple Data Acquisition System

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The potential of non-linear dynamical systems serving as reservoirs has attracted much attention for physical realization of reservoir computing (RC). Here, we demonstrated an RC scheme with solutions as the reservoir, signaling in which are provided by electrochemical reaction and detected by multiple data acquisition system. The essence of signals is ionic current passing through the solution and electrical-chemical current. Following input driving voltage signal, current is detected at metal electrode surface. The current shows enough followability and nonlinearity against the input, which eventually makes dynamical response so that realize the functionality as a reservoir. Multiple data acquisition system consists of a number of metal electrode terminals attached to the solution as well as parallel and switchable current measurement electric circuit boards enable us to measure terminals coinstantaneously and complete the data acquisition in an endurable short time scale.

Fig.1 shows dispersed output current detected at different terminals in distilled water when a random voltage ±1 was applied into the solution from one terminal. The wide divergence implies that the signal response has dynamics, where the locational difference of the terminals makes difference in each other's. Fig. 2 shows performance of our ionic conduction reservoir on the second-order nonlinear dynamic NARMA2 task, where a total of 200 nodes were used. Normalized mean square error (NMSE) is 0.020. We measured in some kinds of pure solution, e.g. distilled water, ethanol and N,N-dimethylformamide (DMF). The distilled water shows maximum memory capacity and minimum error for the second-order nonlinear dynamic task. Electrochemical reaction at the electrode surface and mobilities of added ion should change the signal response. Further trial will open the way to improve the chemical signals to perform a highly dimensional signal converter which can be utilized in an edge informational devices.

Figure 1 Current of different terminals

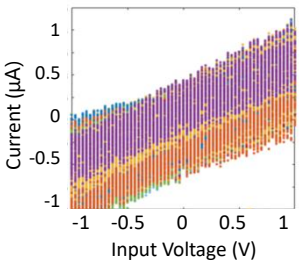

Figure 2 NARMA2 performance of ionic reservoir