Simulation of reservoir computing using dipole-coupled nanomagnet array with different clocking frequency

阪大 [1]，阪大 CSRN[2]

○辻本 知輝 [1]，野村 光 [1,2]，鍬開 雄規 [1]，中谷 亮一 [1]，鈴木 義茂 [1,2]

Osaka Univ. [1], CSRN-Osaka[2]

○K. Tsujimoto[1], H. Nomura[1,2], Y. Kuwabiraki[1], R. Nakatani[1], Y. Suzuki[1,2]

E-mail: kazuki.tsujimoto@mat.eng.osaka-u.ac.jp

Artificial intelligence (AI) has made remarkable achievements in recent years, e.g. AlphaGo[1] from Google DeepMind. However, in general AI, higher performance requires more energy consumption. To reduce the energy consumption, reservoir computing[2] using physical phenomenon for calculation has been reported. We have demonstrated reservoir computing using the stable magnetization state of dipole-coupled nanomagnet array in simulation[3][4]. Besides, some group reported reservoir computing using spin torque oscillator[5]. Therefore, it is expected that magnetization dynamic state of dipole-coupled nanomagnet array will be also useful for reservoir computing.

Here, we demonstrate reservoir computing using dipole-coupled nanomagnet array with different clocking frequency in simulation. We calculate magnetization dynamics with Landau-Lifshitz-Gilbert equation using macro-spin model. Fig. 1 shows schematic illustration of dipole-coupled nanomagnet reservoir with macro-spin model. We use magnetizations of all nanomagnets in the reservoir as nodes' state, and they are connected via dipole field. We update reservoir state by controlling magnetic anisotropy of nanomagnets in certain clocking frequency. We simulate in various clocking frequency which range from hundreds of kHz to some GHz, and investigate short-term memory capacity and parity check capacity of the reservoir.

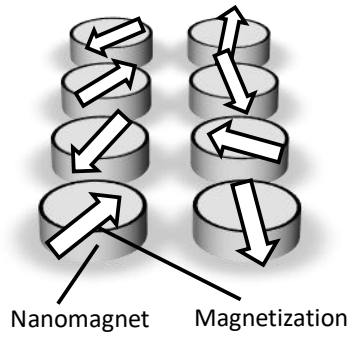

Fig. 1 Schematic illustration of dipole-coupled nanomagnet reservoir with macro-spin model.

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Reference

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