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BOOK OF ABSTRACTS

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DH-04. A Simple 2-Head 2-Track Detection Method for Staggered Bit-Patterned Magnetic Recording. *P. Kovintavewat*[1], S. Koonkarnkhai[1] and C. Warisarn[2] *1. Data Storage Technology Research Center, Nakhon Pathom Rajabhat University, Nakhon Pathom, Thailand; 2. College of Advanced Manufacturing Innovation, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand*

Inter-track interference (ITI) is a major problem for bit-patterned magnetic recording (BPMR) [1] because it degrades the overall system performance. Generally, the BPMR system with staggered islands (see Fig. 1(a)) [2] experiences less ITI effect than that with regular islands. This paper proposes a simple 2-head 2-track detection method to further alleviate ITI for a staggered BPMR system. To do so, the two read heads are used to read data from two adjacent tracks, and each readback signal is oversampled at time $t = kT_x/2$ to obtain two sequences $\{y^i_k$ and $y^i_{k+Tx/2}\}$, where $i \in \{1, 2\}$ is the i-th head and T_x is a bit period. To subside ITI, the weighted readback signal of the 2-nd track is subtracted from the readback signal of the 1-st track to obtain the refined readback signal $r^1_k = y^1_k - \alpha_2 y^2_{k+Tx/2}$. Similarly, the refined readback signal of the 2-nd track is given by $r_k^2 = y^2_k - \alpha_1 y^1_{k-Tx/2}$, where α_1 and α_2 are weighting factors. Without track mis-registration, we can set $\alpha_1 = \alpha_2 = \alpha$, which can be derived as $\alpha = \exp(-0.5(T_z/0.42466W_z)^2)$, where T_z is a track pitch and W_z = 24.8 nm [1]. After ITI mitigation, the refined readback signals are equalized to the 2x3 targets by 1D equalizers, designed based on a minimum mean-squared error approach [3], followed by the 2D Viterbi detectors [4] to determine the most likely input sequences $\hat{a}_{1,k}$ and $\hat{a}_{2,k}$ (see Fig. 1(b)). Here, we introduce the 2x3 target and that with zero corner, whose trellis has 16 states with 4 incoming/outgoing branches and 4 states with 4 incoming/outgoing branches at each state, respectively. We define the signal-to-noise ratio as $SNR = 10\log_{10}(1/\sigma^2)$ in decibel (dB), where σ^2 is noise power. Fig. 2 compares the average bit-error rate (BER) performance at an areal density of 2 and 2.5 Tb/in^2, where the conventional system uses one head to read data and 1D equalizer with the 1D and 2D Viterbi detectors. Clearly, the proposed system performs better than the conventional system at an expense of using two read heads and an oversampled system. Therefore, the performance gain obtained from the proposed method must be balanced against the increased implementation cost.

[1] S. Nabavi, "Signal processing for bit-patterned media channel withinter-track interface," Ph.D. dissertation, Carnegie Mellon University, (2008) [2] Y. Ng, et al., "Channel Modeling and Equalizer Design for Staggered Islands Bit-Patterned Media Recording," IEEE Trans. Magn., vol. 48, no. 6, (2012) [3] J. Moon et al., "Equalization for maximum likelihood detector," IEEE Trans. Magn., vol. 31, no. 2, (1995) [4] S. Koonkarnkhai, et al. "Two-dimensional cross-track asymmetric target design for high-density bit-patterned media recording," in proc. of ISPACS 2011, (2011)

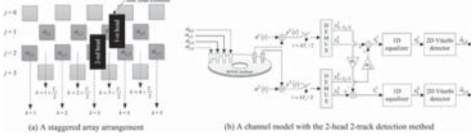

Fig.1 (a) A BPMR medium and (b) a channel model.

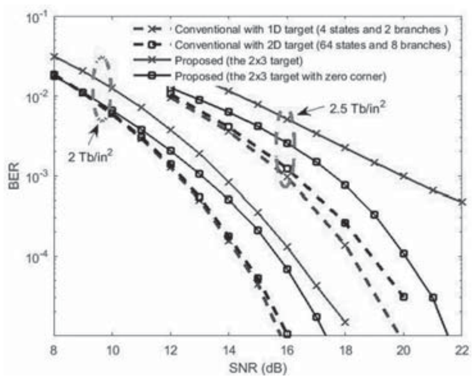

Fig.2 BER performance.

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DH-05. Thermal activation effect in microwave assisted switching of CoCrPt granular media. *N. Kikuchi*[1,2], S. Kikuchi[3], K. Shimada[3], K. Sato[1], S. Okamoto[1,2], O. Kitakami[1,2] and T. Shimatsu[3,4] *1. IMRAM Tohoku University, Sendai, Japan; 2. CSRN Tohoku University, Sendai, Japan; 3. FRIS Tohoku University, Sendai, Japan; 4. RIEC Tohoku University, Sendai, Japan*

Analytical calculation has revealed that energy landscape for microwave assisted switching (MAS) strongly depends on the excitation frequency [1]. We have investigated thermal activation behavior of CoCrPt granular media by measuring time- and frequency dependence of coercivity. A CoCrPt granular medium of 15 nm in thickness was deposited with underlayers on a gold co-planar waveguide of 1 μm in width for rf field application. The CoCrPt medium was patterned into a rectangular bar of 1 × 3 μm^2 using conventional lithography processes. Magnetization curves were measured by detecting anomalous Hall effect (AHE) of the medium. MAS experiments were carried out by sweeping dc field along the film normal, while in-plane rf fields were applied as pulse trains with fixed duration t_{pulse} = 20 ns and period t_{period} = 20 μs – 2 s. Figure 1 shows coercivity H_c of the CoCrPt granular medium as a function of rf field frequency f_{rf} measured at t_{period} = 20 μs, 6 ms, and 2 s. Coercivity measured without h_{rf}, H_c^{dc} = 4.7 kOe, is indicated as a dotted line in Fig. 1. By applying h_{rf} coercivity linearly decreases with increase of f_{rf} up to f_{rf}=18 GHz, then gradually increase with increase of f_{rf} for all the t_{period}. Coercivity decreases with decreasing t_{period}, because the switching probability due to thermal activation effect becomes higher by longer effective pulse field application time t_{eff} $(=t_{meas}\times t_{pulse}/t_{period})$. The change of coercivity by t_{eff} becomes significant in the frequency range f_{rf} > 18 GHz. We have also found similar frequency- and time-dependent behavior in LLG micromagnetics simulation including thermal effect, suggesting that frequency dependent energy landscape would play an important role in frequency dependence of coercivity.

[1] H. Suto et al., Phys. Rev. B Vol. 91, p. 094401 (2015)