THREE-PATH SOFT OUTPUT VITERBI ALGORITHM FOR STAGGERED BIT-PATTERNED MEDIA RECORDING

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I. INTRODUCTION

Bit-patterned media recording (BPMR) is one of candidate for the next generation magnetic recording system to extend the density of up to 4 Tb/in^2 [1]. However, the overall performance of BPMR is mainly degraded by inter-symbol interference (ISI), inter-track interference (ITI), and media noise. Depending upon the lithography approach adopted islands structures of BPMR can be arranged in a regular or staggered array islands. Since staggered BPMR system has some advantages to reduce the effect of ITI, the bit error rate (BER) performance of staggered BPMR system is better than that of regular one at the same density [2]. However, detection schemes proposed for regular BPMR is unfit for staggered BPMR and it is necessary for staggered BPMR system to find an appropriate detection scheme for improving the performance. In this paper, we proposed a three-path soft output Viterbi algorithm (3P-SOVA) for staggered BPMR.

II. THREE-PATH SOFT OUTPUT VITERBI ALGORITHM

Since islands on neighboring tracks are directly adjacent to the islands on a main data track in regular array islands BPMR, islands on the main data track is mainly affected by the most proximate two islands on the neighboring tracks (one of the islands is on upper track and the other is on lower track). Thus, one SOVA for the vertical (across-track) direction is usually used in two-dimensional (2D) SOVA which is comprised of horizontal (along-track) SOVA and vertical SOVA. Since islands along the neighboring tracks are displaced by half a period along the main data track in staggered BPMR, islands on the main data track is mainly affected by the most proximate four islands on the neighboring tracks (two of the islands are on upper track and the others are on lower track).

Fig. 1 shows configuration of two SOVAs for vertical direction z_1 and z_2 over the staggered array islands. When 2D-SOVA is used in staggered BPMR, horizontal SOVA of 2D-SOVA is only considered for the along-track direction, but vertical SOVA of 2D-SOVA is considered for the across-track direction of z_1 or z_2. To consider islands arranged in the staggered manner and improve the system performance, we proposed 3P-SOVA. Fig. 2 shows the block diagram of the proposed 3P-SOVA detection which is composed of horizontal SOVA and two vertical SOVAs for z_1 and z_2. After the input data $d[p, q]$ is passed through the BPMR channel, the received data $r[p, q]$ is processed by the 2D equalizer. 3P-SOVA separately processes the 1D-SOVA detection for the along-track direction and across-track direction of z_1 and z_2, respectively. And, the final output value of 3P-SOVA is the average of the soft output values of each SOVA.

III. SIMULATION AND RESULTS

We consider the discrete-time staggered BPMR channel. A 2D equalizer is implemented by finite impulse response. The coefficients are updated by a least mean square algorithm. The partial response (PR) targets for 1D-SOVAs are (0.2, 1, 0.2) and (0.15, 1, 0.15) for the along- and across-track direction, respectively. Fig. 3 illustrates the BER performance of detection schemes such as 1D-SOVA, 2D-SOVA and 3P-SOVA according to signal-to-noise ratio at density of 2 Tb/in^2. At BER of 10^{-5}, the performance of the 3P-SOVA is around 1.7dB and 0.7dB better than that of 1D-SOVA and 2D-SOVA.

IV. CONCLUSION

In this paper, we proposed a 3P-SOVA which utilizes three SOVAs for the along- and across-track

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direction for z_1 and z_2, respectively. Since 3P-SOVA is considered for two across-track direction of z_1 and z_2, respectively, simulation results show that the performance of 3P-SOVA performs better than that of 1D-SOVA and 2D-SOVA.

REFERENCES

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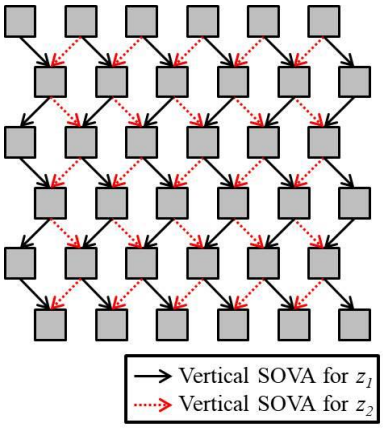

Fig. 1 Configuration of two SOVAs for vertical direction.

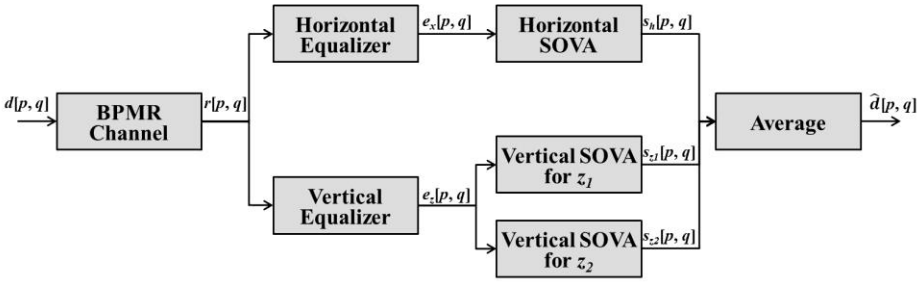

Fig. 2 Block diagram of the proposed 3P-SOVA detection.

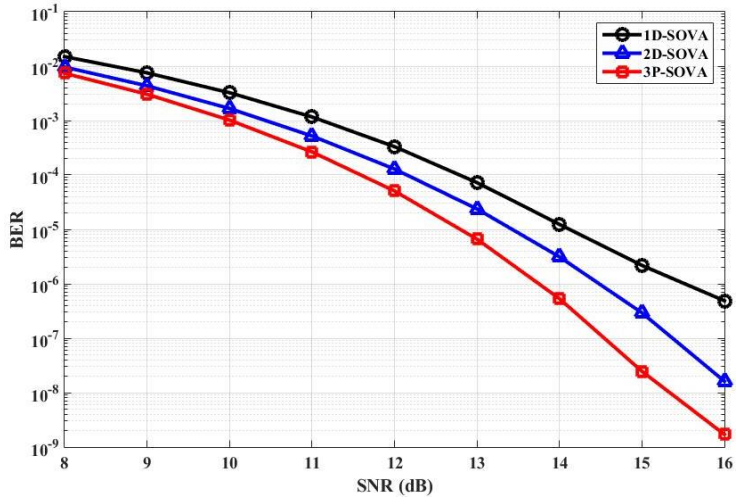

Fig. 3 BER performance of detection schemes at 2 Tb/in^2.