ABSTRACT

In future high areal density magnetic recording systems including Bit patterned media recording (BPMR), the prominent challenges to be addressed are two-dimensional (2-D) interference: Inter-symbol interference (ISI) and Inter-track interference (ITI) due to narrow the bit pitch and the track pitch, the media noise due to the size and position fluctuation, and track mis-registration (TMR) due to the misalignment of the head and the media. Without tackling them properly, they can severely impact on the performance of the read channel of magnetic recording systems. In the literature, read channels utilizing multi-head multi-track (MHMT) recording technology have been proposed to solve those problems because it can effectively tackle the 2-D interference and other impairments by processing multiple readback signals. However, most of proposed read channel system avoided full-fledged multi-track joint detection technique because of its impractically high complexity even though it is the most effective technique to combat 2-D interference in other areas such as image processing multi-input multi-output (MIMO) wireless communication.

Therefore, the aim of this research project is to design a novel advanced joint signal processing scheme with low complexity for multi-head multi-track recording system that can tackle the prominent problems in BPMR and other high density magnetic recording systems. In the project, various configurations of MHMT recording channel of BPMR systems are investigated and the trade-off between the performance and the complexity of the systems are made. Then, a low complexity multi-track joint detector is developed with the help of 2-D generalized partial response (GPR) equalization to recovery the recorded bits from the detecting tracks as well as from the sidetracks. Moreover, noise predictive Viterbi detectors for MHMT read channel of BPMR systems are studied and the project proposed a noise prediction technique based on the recorded noise information at the consecutive states along the surviving path leading to the current states. Finally, we proposed a TMR estimation technique with the terms of the coefficients of GPR target which is designed based on minimum mean squared error (MMSE) techniques.