Experimental Characterization of Transition Noise in HAMR

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Introduction

Due to the sensitivity of the write process to temperature variations and laser position alignment [1][2], transition noise in HAMR may exhibit characteristics that are significantly different from those of perpendicular magnetic recording (PMR). In this work, statistical properties of transition noise in HAMR are investigated using real data taken off a spin stand. The Karhunen–Loeve (K-L) expansion method is applied to the read waveforms corresponding to a pseudorandom bit pattern written at varying locations of a disk.

Experimental Procedure

A 127-bit pseudorandom pattern is written on different positions of the disk. The HAMR system under study employs a FePtL10 thin-film disk and a shielded pole head designed for PMR. Each 127-bit pattern is read repeatedly to remove additive system noise via averaging. The averaged read waveforms are interpolated with sufficient resolution and then aligned based on the least square principle. The aligned waveforms constitute an ensemble that contains meaningful statistical variations involving transitions within different local bit patterns. The K-L expansion allows decomposition of the noise associated with isolated transitions into different orthogonal directions corresponding to position jitter and width fluctuations [3]. In this work, we apply the K-L expansion to the read waveforms corresponding to crowded transition patterns in HAMR, in order to develop insights into data-dependent transition noise characteristics.

Results

The results indicate that for the HAMR system under investigation the transition width variation effect is significantly larger than the transition position jitter effect in terms of total noise power contributions associated with isolated transitions. When the noise decomposition technique is applied to isolated transition-pairs ("dibits"), we observe that the major components of the medium noise are amplitude fluctuations and highly-correlated position shifts of transition-pairs. We conjecture that the strong dependency of the HAMR write process on local temperature and laser-position alignment induce significant positive correlation on the widths or positions of closely spaced transitions.

References

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