Simply changing the pattern by which data is recorded may lead to increased hard drive capacities, study finds

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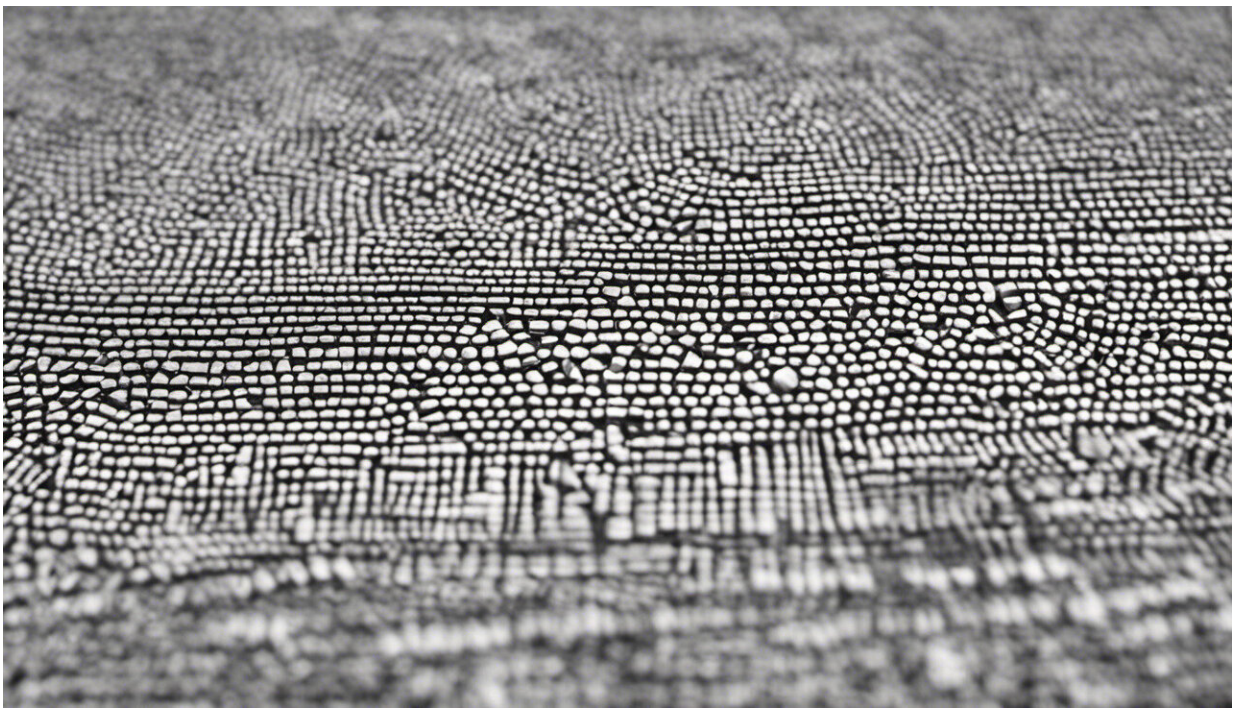

Credit: AI-generated image (disclaimer)

Modern hard drive technology is reaching its limits. Engineers have increased data-storage capacities by reducing the widths of the narrow tracks of magnetic material that record data inside a hard drive. Narrowing these tracks has required a concordant reduction in the size

of the magnetic write head—the device used to create them. However, it is physically difficult to reduce the size of write heads any further. Kim Keng Teo and co-workers at the A*STAR Data Storage Institute, Singapore, and the Niigata Institute of Technology, Japan, have recently performed an analysis that highlights the promise of an alternative approach, which may sidestep this problem completely.

In a conventional hard drive, a write head stores data by applying a magnetic field to a series of parallel, non-overlapping tracks. Halving the width of the track effectively doubles the data-storage capacity, but also requires the size of the write head to be halved. The head therefore produces less magnetic field than is needed to enable stable data storage. This is because the small magnetic grains that are characteristic of modern hard drive media need to be thermally stable at room temperature.

Shingled magnetic recording represents a step towards solving this problem as it allows for narrower track widths without smaller write heads. Rather than writing to non-overlapping tracks, the approach overlaps tracks just as shingles on a roof overlap (see image). Tracks are written in a so-called 'raster' pattern, with new data written to one side only of the last-written track.

Teo and co-workers analyzed the scaling behavior of this approach by using both numerical analysis and experimental verification. Their results showed that the size of the data track is not limited by the size of the write head, as in conventional hard drives. Instead, the track size is limited by the size of the magnetic read head, and by the 'erase bandwidth', which represents the portion of the track edge that is affected by adjacent tracks.

"This is a paradigm shift for the industry," says Teo. "A relatively small difference in the way that writing occurs calls for a completely new

approach to head design." Teo expects the shingled approach to be a useful stop-gap measure prior to the arrival of more advanced, next-generation technologies in the next decade or so that will apply more radical modifications to the hard drive such as the use of heat to assist the write head.

More information: Teo, K. et al. Analysis and design of shingled magnetic recording systems. *Journal of Applied Physics* 111, 07B716 (2012). jap.aip.org/resource/1/japiau/v111/i7/p07B716_s1

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