The solution to faster computing? Sing to your data

November 3 2015

Nothing is more frustrating that watching that circle spinning in the centre of your screen, while you wait for your computer to load a programme or access the data you need. Now a team from the Universities of Sheffield and Leeds may have found the answer to faster computing: sound.

The research - published in *Applied Physics Letters* - has shown that certain types of sound waves can move data quickly, using minimal power.

The world's 2.7 zettabytes (2.7 followed by 21 zeros) of data are mostly held on hard disk drives: magnetic disks that work like miniaturised record players, with the data read by sensors that scan over the disk's surface as it spins. But because this involves moving parts, there are limits on how fast it can operate.

For computers to run faster, we need to create "solid-state" drives that eliminate the need for moving parts - essentially making the data move, not the device on which it's stored. Flash-based solid-state disk drives have achieved this, and store information electrically rather than magnetically. However, while they operate much faster than normal hard disks, they last much less time before becoming unreliable, are much more expensive and still run much slower than other parts of a modern computer - limiting total speed.

Creating a magnetic solid-state drive could overcome all of these

problems. One solution being developed is 'racetrack memory', which uses tiny magnetic wires, each one hundreds of times thinner than a human hair, down which magnetic "bits" of data run like racing cars around a track. Existing research into racetrack memory has focused on using magnetic fields or electric currents to move the data bits down the wires. However, both these options create heat and reduce power efficiency, which will limit battery life, increase energy bills and CO2 emissions.

Dr Tom Hayward from the University of Sheffield and Professor John Cunningham from the University of Leeds have together come up with a completely new solution: passing sound waves across the surface on which the wires are fixed. They also found that the direction of data flow depends on the pitch of the sound generated - in effect they "sang" to the data to move it.

The sound used is in the form of surface acoustic waves - the same as the most destructive wave that can emanate from an earthquake. Although already harnessed for use in electronics and other areas of engineering, this is the first time surface acoustic waves have been applied to a data storage system.

Dr Hayward, from Sheffield's Faculty of Engineering, said: "The key advantage of surface acoustic waves in this application is their ability to travel up to several centimetres without decaying, which at the nano-scale is a huge distance. Because of this, we think a single sound wave could be used to "sing" to large numbers of nanowires simultaneously, enabling us to move a lot of data using very little power. We're now aiming to create prototype devices in which this concept can be fully tested."

More information: J. Dean et al. A sound idea: Manipulating domain walls in magnetic nanowires using surface acoustic waves, *Applied*

Physics Letters (2015). DOI: 10.1063/1.4932057