Faster computation of electromagnetic interference on an electronic circuit board

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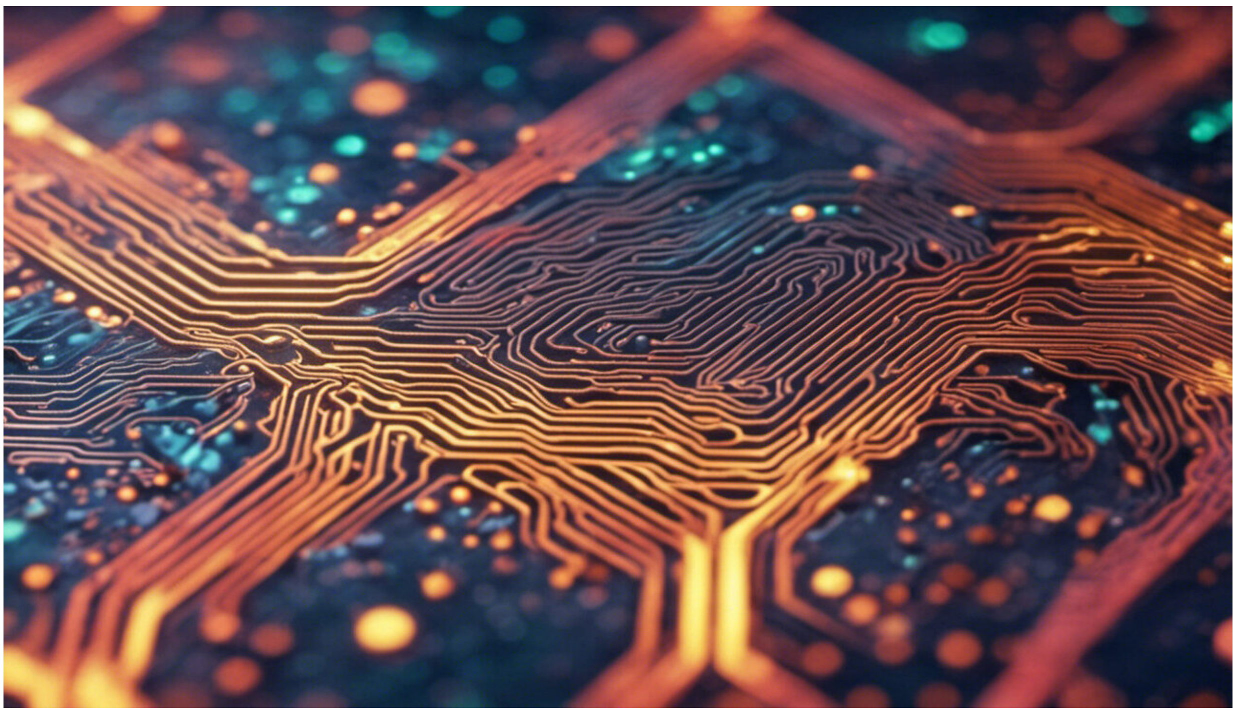

Credit: AI-generated image (disclaimer)

As electronic components on electronic circuit boards continue to shrink, problems of electromagnetic compatibility are arising. Such problems include unwanted 'noise' effects due to electromagnetic interference and susceptibility. "Electromagnetic interference is a critical problem for the electronics industry," explains Xian-Ke Gao from the A*STAR Institute of High Performance Computing in Singapore. "Engineers are keen to understand how the electronic circuits react. However, it is difficult to measure such effects experimentally, because disassembling the device would affect the physical testing."

To address this problem, the electronics industry has developed a suite of computer modeling tools, but these are cumbersome and require a lot of computing power. Now, Gao and colleagues have developed a computer model that is able to solve such problems more than ten times faster than existing models.

Fairly coarse models are typically used to model electromagnetic interference effects on electronic circuit boards (see image). To do this, the device is divided into a grid of small cubes, and the electromagnetic fields to and from each cube are modeled individually. This approach requires a lot of computing power, especially if the grid size is small, but it has the advantage that it is flexible and can be adapted to various geometries. Except for interference effects, the same computer models can be applied to calculate electromagnetic fields for a range of electrical devices other than circuit boards.

A more targeted and efficient approach is required to measure interference effects. Researchers use mathematical equations to describe the electrical currents in a conducting wire. The physics of these transmission-line equations are well understood and, once adapted to the unique properties of circuit boards, are far easier to solve by a computer algorithm than the other, coarser modeling.

The first tests of the software package developed by the A*STAR researchers, which is based on the transmission-line equations, reliably solved a number of standard problems for electronic circuits. Compared to commercial models, the new software achieved very good agreement, especially for the main region of interest—frequencies below one gigahertz.

Speed, however, is the key advantage of using the software. Whereas commercial software requires more than two hours of computing on a regular laptop, the A*STAR software package needed less than ten minutes for the same task, explains Gao. "Our computational problem-solving kit can shorten electromagnetic interference trouble-shooting in the product design phase and therefore translates into time and cost savings for the industry."

More information: Gao, X.-K., Zhao, H., Li, E.-P. & Hoefer, W. J. R. "Radiated electromagnetic immunity analysis of flex cable with ground plane using transmission line equations." *IEEE Transactions on Electromagnetic Compatibility* 55, 875–882 (2013). dx.doi.org/10.1109/TEMC.2013.2242079

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