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Brain model explores the cause of different epileptic seizure onset patterns

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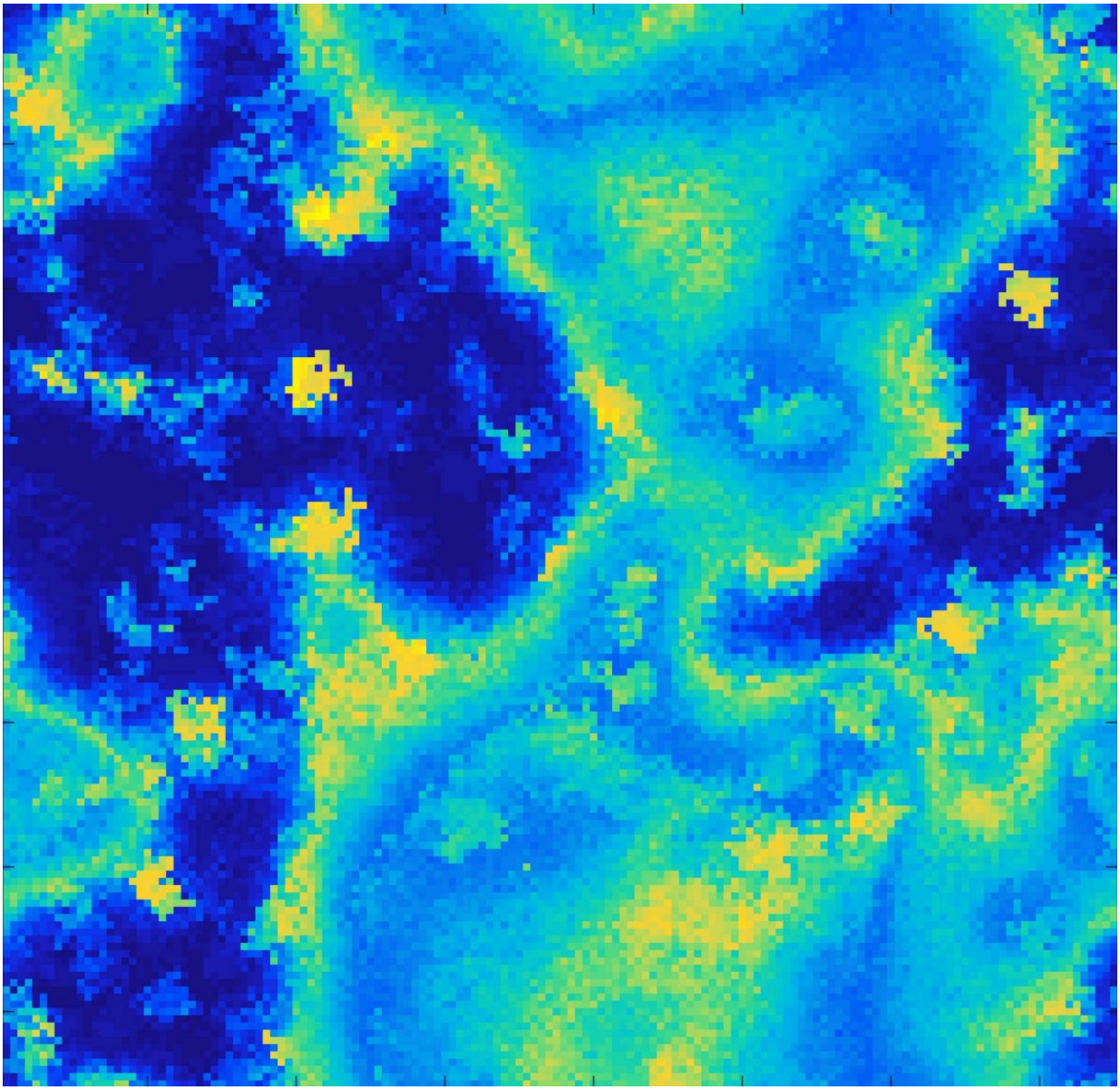

Simulated seizure activity on cortical tissue. Credit: Simulation by Y. Wang

At the onset of an epileptic seizure, differing characteristics of brain tissue surrounding the seizure's origin site may determine which of two main patterns of brain activity will be seen, according to a study in *PLOS Computational Biology*.

Electrical activity in the brain at the start of an epileptic seizure typically follows either a "low amplitude fast" pattern or a "high amplitude slow" pattern. Patients whose seizures follow the high amplitude slow pattern have a higher risk of continuing seizures after surgical treatment. However, the mechanisms underlying these different onset patterns are unclear.

To better understand the onset patterns, Yujiang Wang of Newcastle University, U.K., and colleagues used a previously developed computer model that can simulate brain activity at the start of a seizure. The model output suggested that the onset pattern of a seizure may be determined not by brain tissue at the site where the seizure originates, but by characteristics of the surrounding "healthy" brain tissue.

The simulation showed that the high amplitude slow pattern occurs when surrounding brain tissue has higher excitability; that is, the brain cells have a stronger response to stimulation and can react immediately to the initiation of a seizure. Meanwhile, the low amplitude fast pattern is associated with tissue of lower excitability, which is only slowly penetrated by seizure activity.

These findings suggest why the different onset patterns are associated with different treatment outcomes. Surgical removal of seizure-triggering brain tissue may be enough to prevent seizure activity in

nearby low-excitability tissue. However, high-excitability tissue may still be stimulated by alternative trigger sites after surgery, providing a possible explanation for the worse outcomes experienced by patients whose seizures follow the high amplitude slow pattern.

Next, the researchers plan to study seizure onset patterns in greater detail. "We hope to contribute towards the overall goal of associating patterns seen in seizures with an understanding of the underlying mechanism," Wang says. "This would not only help our understanding of seizures in general, but may be useful for patient stratification in terms of treatment options."

More information: Wang Y, Trevelyan AJ, Valentin A, Alarcon G, Taylor PN, Kaiser M (2017) Mechanisms underlying different onset patterns of focal seizures. *PLoS Comput Biol* 13(5): e1005475. doi.org/10.1371/journal.pcbi.1005475

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