intelligence — to predict the future evolution of chaotic systems out to stunningly distant horizons. The approach is being lauded by outside experts as groundbreaking and likely to find wide application.

“I find it really amazing how far into the future they predict” a system’s chaotic evolution, said Herbert Jaeger, a professor of computational science at Jacobs University in Bremen, Germany.

The findings come from veteran chaos theorist Edward Ott and four collaborators at the University of Maryland. They employed a machine-learning algorithm called reservoir computing to “learn” the dynamics of an archetypal chaotic system called the Kuramoto-Sivashinsky equation. The evolving solution to this equation behaves like a flame front, flickering as it advances through a combustible medium. The equation also describes drift waves in plasmas and other phenomena, and serves as “a test bed for studying turbulence and spatiotemporal chaos,” said Jaideep Pathak, Ott’s graduate student and the lead author of the new papers.

Faye Levine/University of Maryland

Jaideep Pathak, Michelle Girvan, Brian Hunt and Edward Ott of the University of Maryland, who (along with Zhixin Lu, now of the University of Pennsylvania) have shown that machine learning is a powerful tool for predicting chaos.

After training itself on data from the past evolution of the Kuramoto-Sivashinsky equation, the researchers’ reservoir computer could then closely predict how the flamelike system would continue to evolve out to eight “Lyapunov times” into the future, eight times further ahead than previous methods allowed, loosely speaking. The Lyapunov time represents how long it takes for two almost-