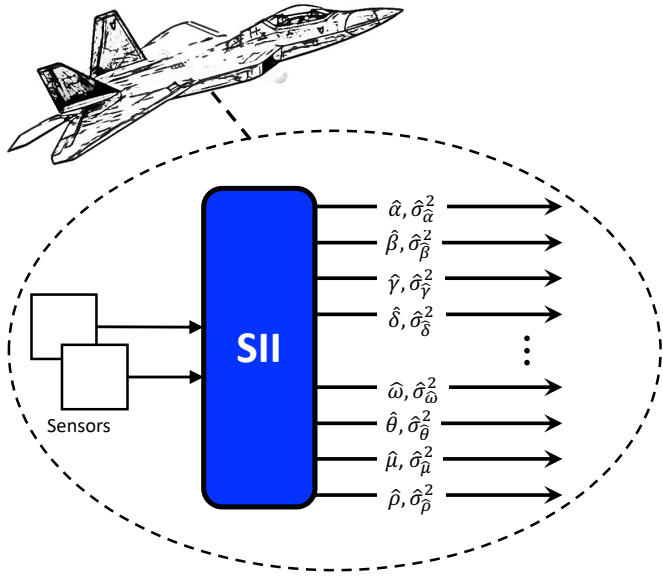


# Spatiotemporal Inferential Intelligence (SII)



# How is comprehensive failure management applied to your system?

## Solution Customization:

- SII is AI software comprising neural networks
- Generally, a first principles model of the target system is needed to develop the data for training its neural networks.
- Technology development to support your system is rapid, on the order of a few days

## Application of SII to your system

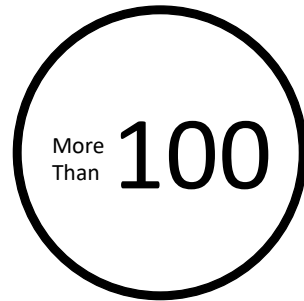
- SII is non-invasive and can run as an auxiliary transducer, requiring a connection to potentially easily available measurements like current and voltage. In some cases, system control inputs are needed
- Accordingly, SII is also inherently remote (as remote as you want it to be) concerning the target system
- SII works offline, as well, attached to outputs from a simulator or MBSE software

## Advantage

### Number of Physical Parameters Inferred per Sensed Measurement



All Other Inferential Sensors\*



SII

Stratos Perception, LLC.

Detect and Mitigate Pending Root Causes ... Before Failures Happen

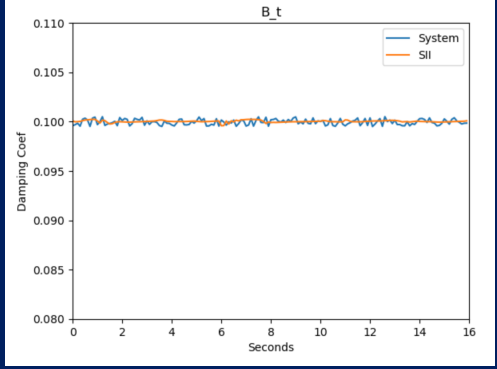
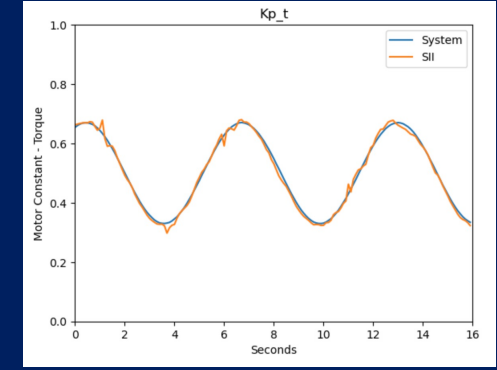
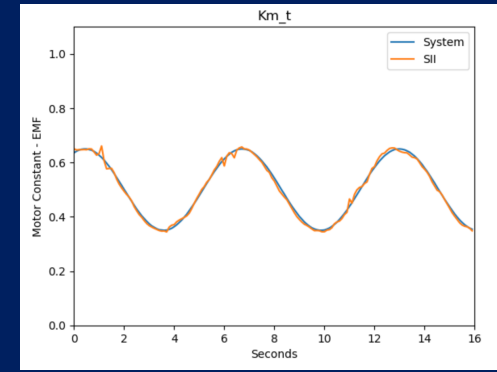
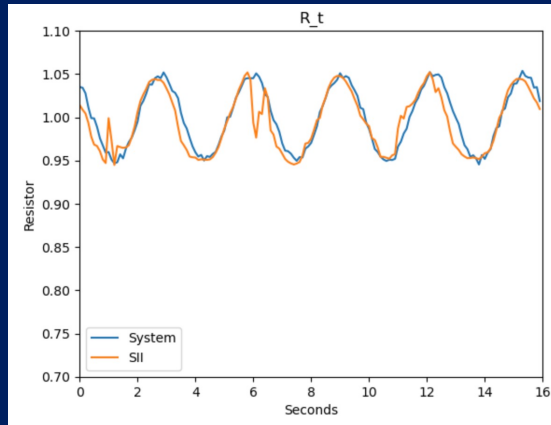
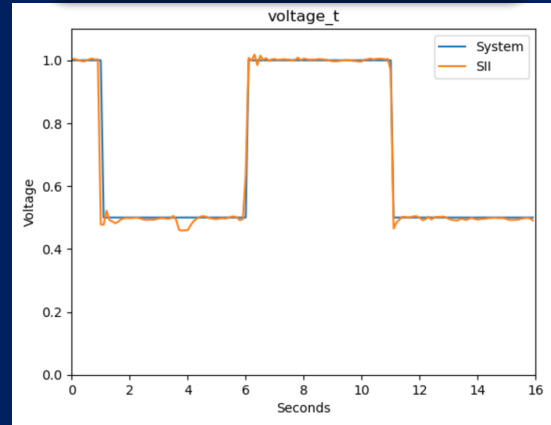
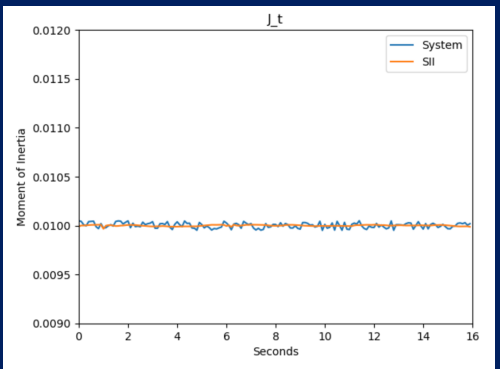
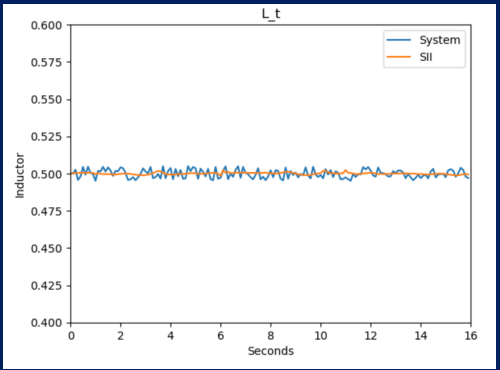
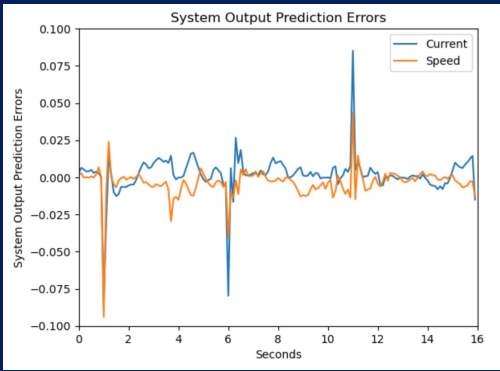


# Demonstration\*

## Simulated Motor Pump

$$\frac{1}{L(t)} \frac{\partial I(t)}{\partial t} = V(t) - R(t)i(t) - K(t)_m \omega(t)$$

$$\frac{1}{J(t)} \frac{\partial \omega(t)}{\partial t} = K(t)_p i(t) - B(t)\omega(t)$$



In this example a motor-pump is simulated via a simple system of ordinary differential equations with all physical parameters time-varying. SII does not receive input that some of the physical parameters of the motor pump are behaving in nonsensical ways. The upper left image is the prediction errors on the two signals that SII is monitoring, current and speed. The other two left hand images and the lower right hand image represent independent parameters that are simulated as behaving stochastically about a constant mean. The other four images show the values of the remaining four inferentially monitored independent parameters which are simulated with sinusoids and step functions (i.e., voltage, motor emf, motor torque, electrical resistance) with noise. Together, the images demonstrate that SII performs accurate estimation (i.e., *inferential monitoring*) on an underconstrained parameter estimation problem, with two independent sensed signals and seven unknown time-varying independent parameters, estimating all time-varying parameter behaviors based on only the prediction errors obtained from the monitoring of current and speed. \*Realistic units of the physics involved were not considered in this demonstration and therefore units are omitted from the data descriptions.