

Distributed Fiber Optic Sensing: Dynamic System for Digital Twins

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Current Technology

Distributed temperature and strain sensing (DTSS) and distributed acoustic sensing (DAS) are used in civil engineering, seismology, and many other fields. DFOS interrogators and fiber-embedded cables have proven performance in the field. Together with IoT networks and numerical methods, DFOS paves the way for large scale digital-twins.



Fig. DFOS facilitates high-fidelity digital twins



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Problem

The key function of a digital twin is utilizing in-situ sensing data and computer models to reflect changes at an appropriate synchronization rate. DAS can support very high interrogation rates but measuring full-scale structures with kilometers of fiber result in huge data volumes up to terabyteorder per day. Processing the DFOS data stream in real-time to fulfill the synchronization rate requirement of digital twins is not trivial.

Sampling rate	Distance range	Data size per 24 hr
1 ksps	5 km	1.6 TB
5 ksps	1 km	1.6 TB
5 ksps	5 km	8 TB
5 ksps	10 km	16 TB
Table. DAS strainrate data quantity examples		

for one day (sampling interval = 1 m)

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Tackling the scaling problem of digital twins requires the optimal combination of hardware and software. The edge processing pipeline (ondevice, in-memory) enables condensing raw acquisition data into necessary engineering data. The result is orders of magnitude smaller than raw data and can be efficiently visualized or transmitted for downstream processing.



 Cost performance better than any other sensor ✓ Interrogators fit the requested precision and speed

Pressure

Acoustic

• • •

Solution

