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Digital Twin Prototype and Concept for EV Mount Integrity Monitoring



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RIEG WEBINAR – ELASTOMER USE IN ELECTRIC VEHICLES

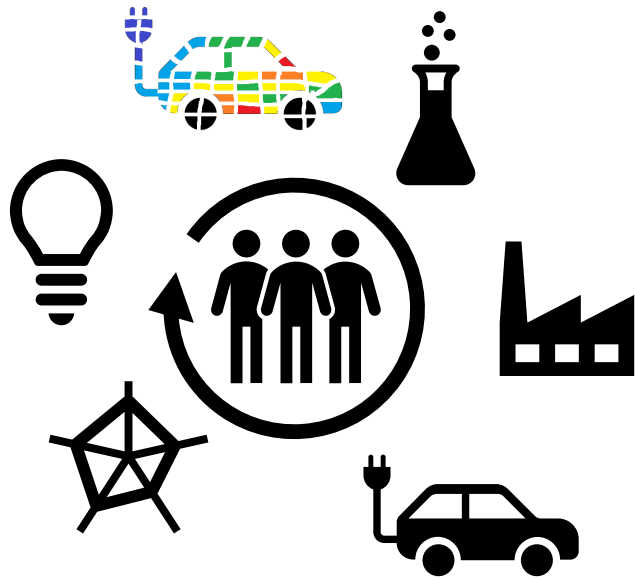


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Simulation Business Models in the Digital Twin Age

Development



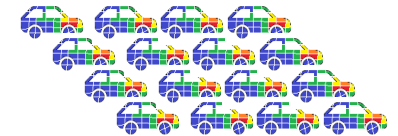
Operations / Logistics /
Maintenance



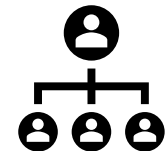
Asset



Twin

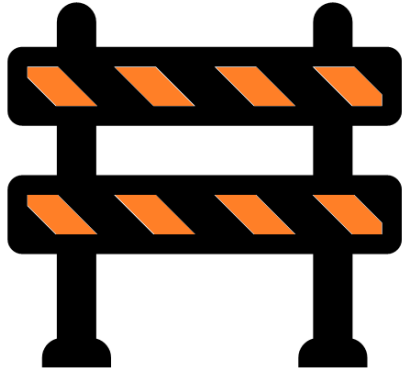


Owner

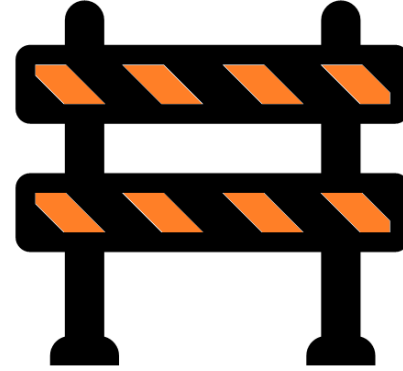


Assumption: Displacements provided

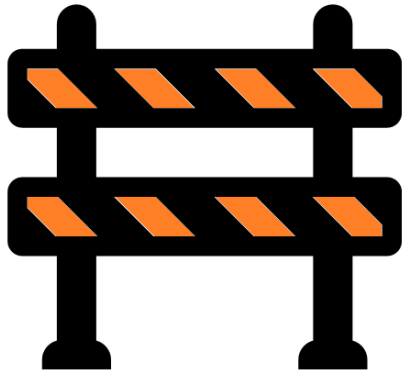
Past Barriers



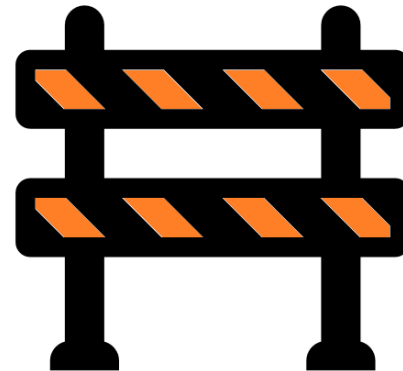
Get finite strain history from load history



Track damage development across time



Do Nonlinear Fatigue analysis of elastomeric part

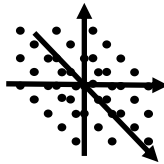
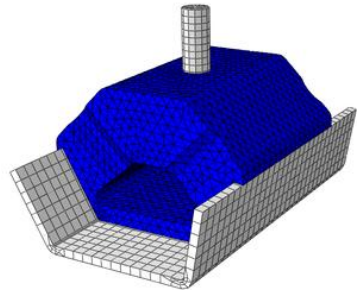


Do it in real time!



Implementation and Initialization

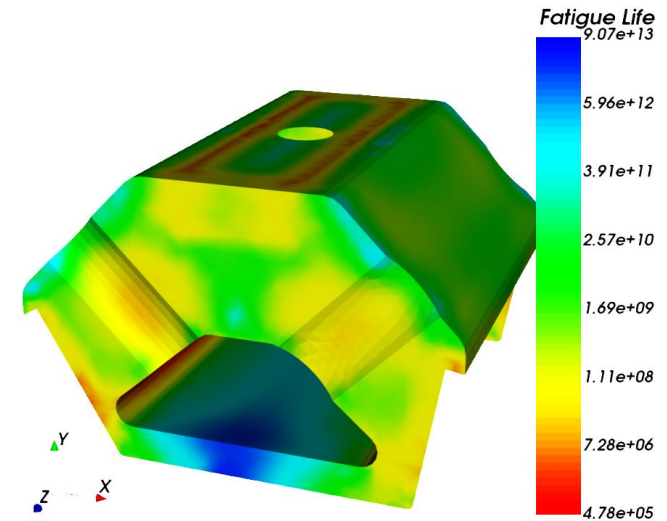
Nonlinear FEA



$dX, dY, dZ \rightarrow \epsilon_{ij}(ele)$

Nonlinear Map

Initialize Residual Life
for standard load case

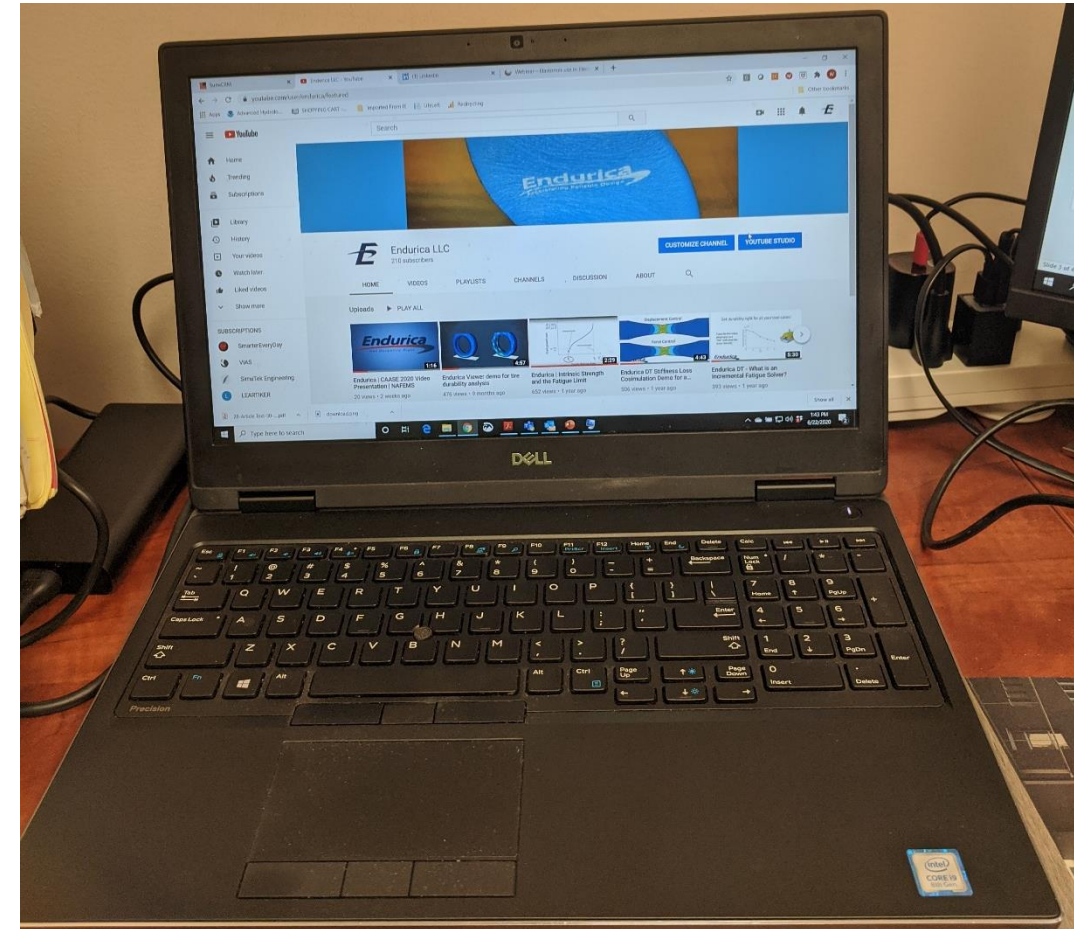


$\epsilon_{ij}(ele) \rightarrow Nf(ele)$



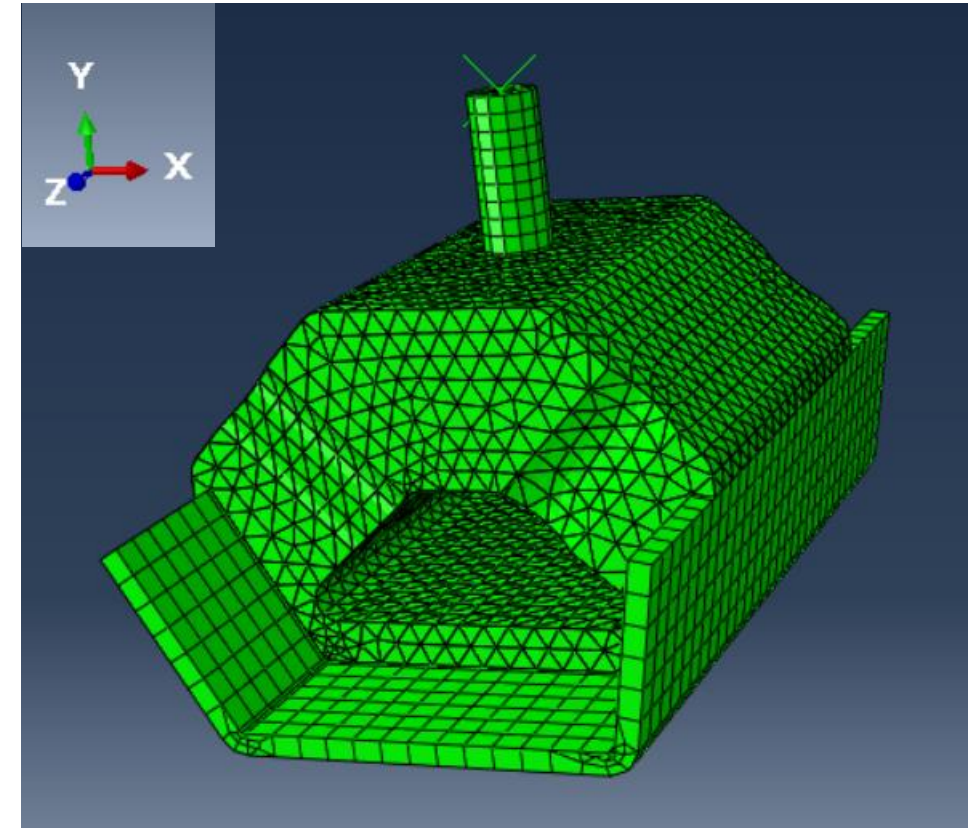
Compute Specs

Processor	Intel i9
CPU	2.9 GHz
Cores	6
Logical Processors	12
RAM	32 GB
Hard Drive Free Space / Capacity	317 GB / 952 GB
OS	Windows 10



Finite Element Model Specs

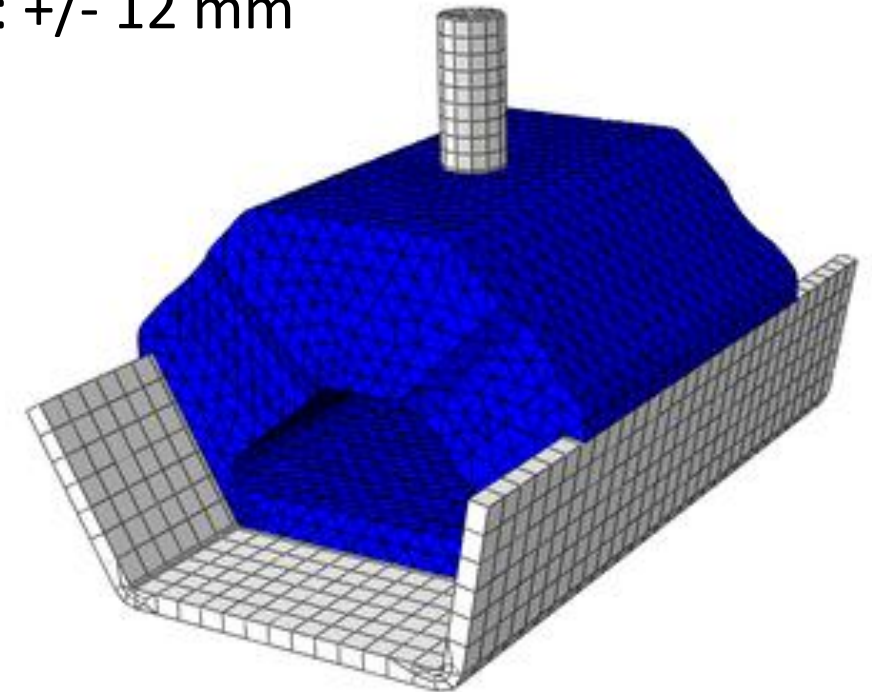
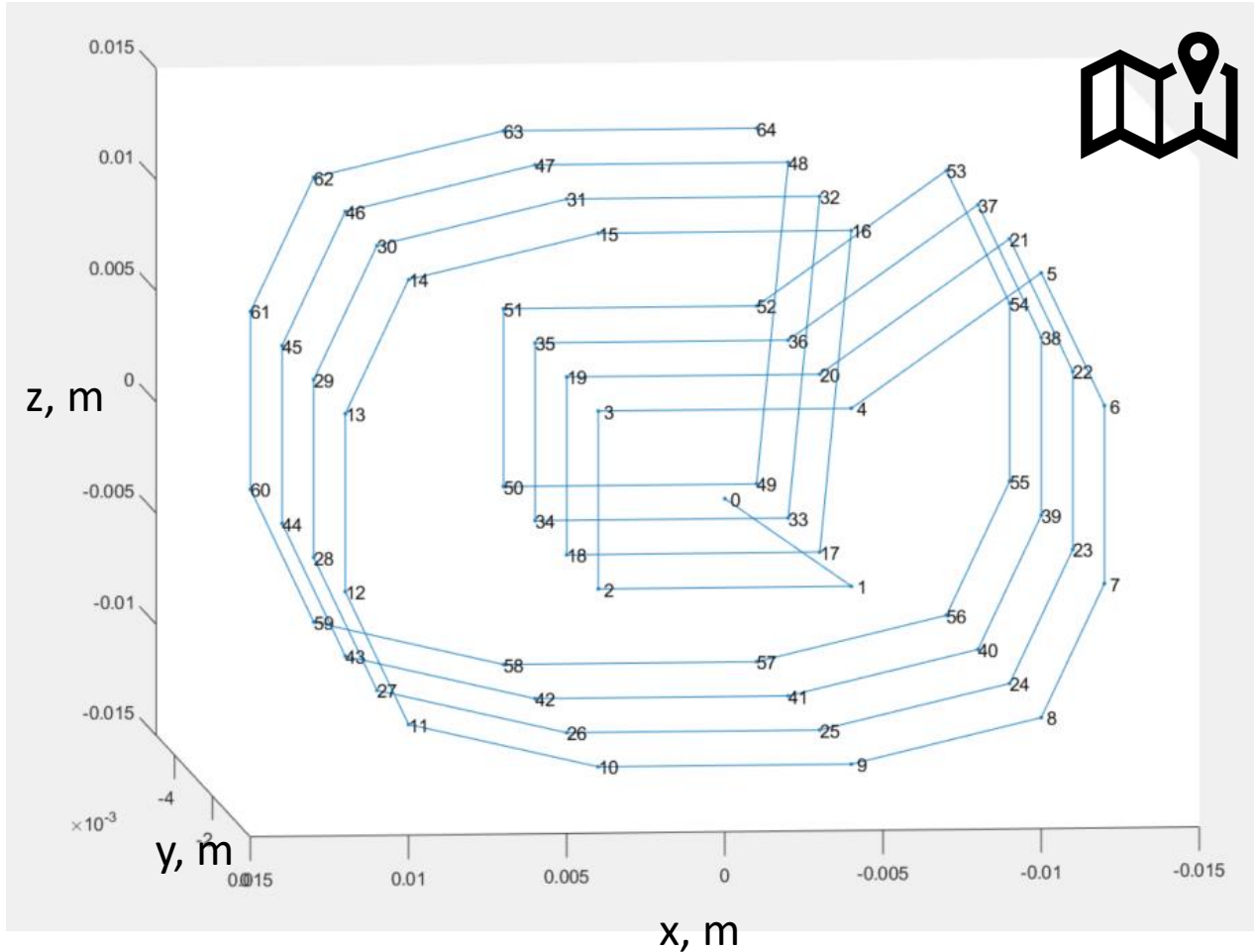
Nodes	38661
Elements	29234
Element Types	C3D10H, M3D6
Time Steps	64 steps
CPU Solve Time	9589 sec



Pre-Computed Finite Element Solutions



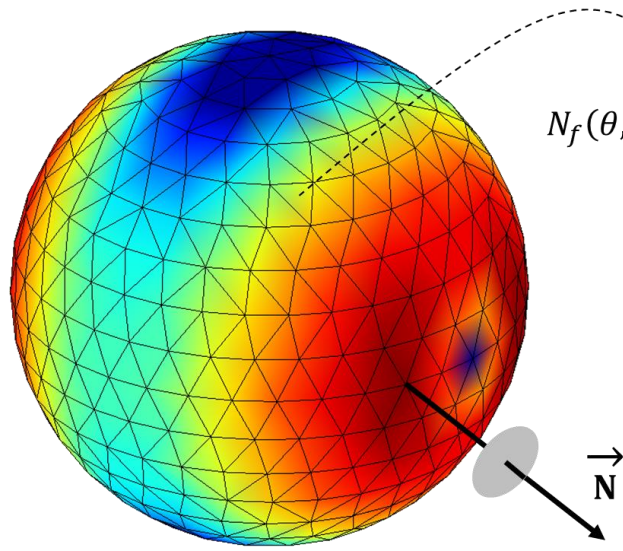
X: +/- 12 mm
Y: 0-5 mm
Z: +/- 12 mm



4 x 4 x 4 = 64 grid points

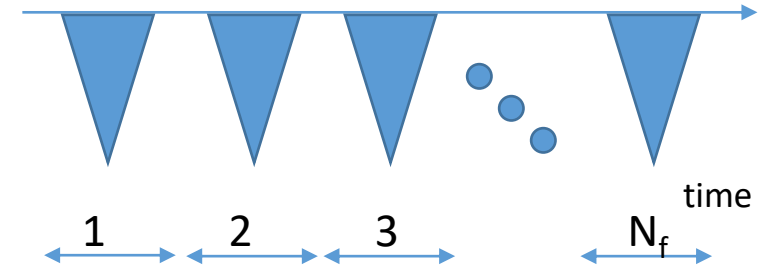
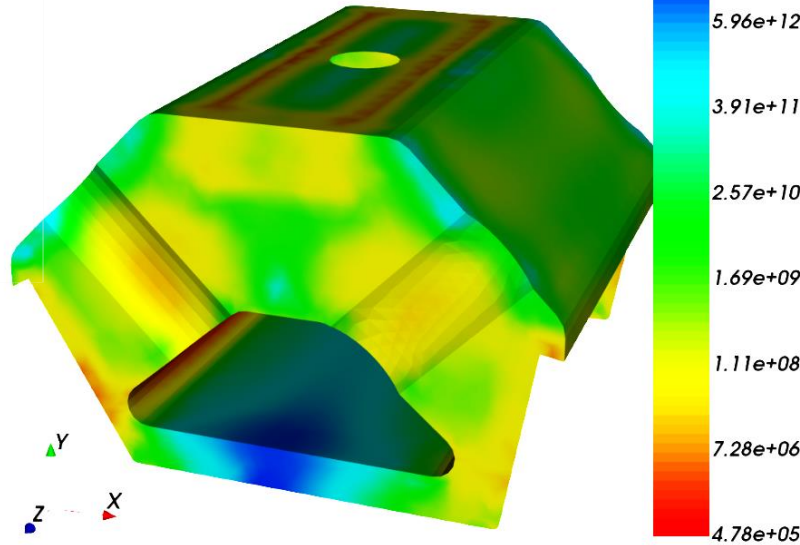


Residual Life / Standard Load Case



$$N_f(\theta, \varphi) = \int_{a_0}^{a_f} \frac{1}{r(T(\theta, \varphi, a))} da$$

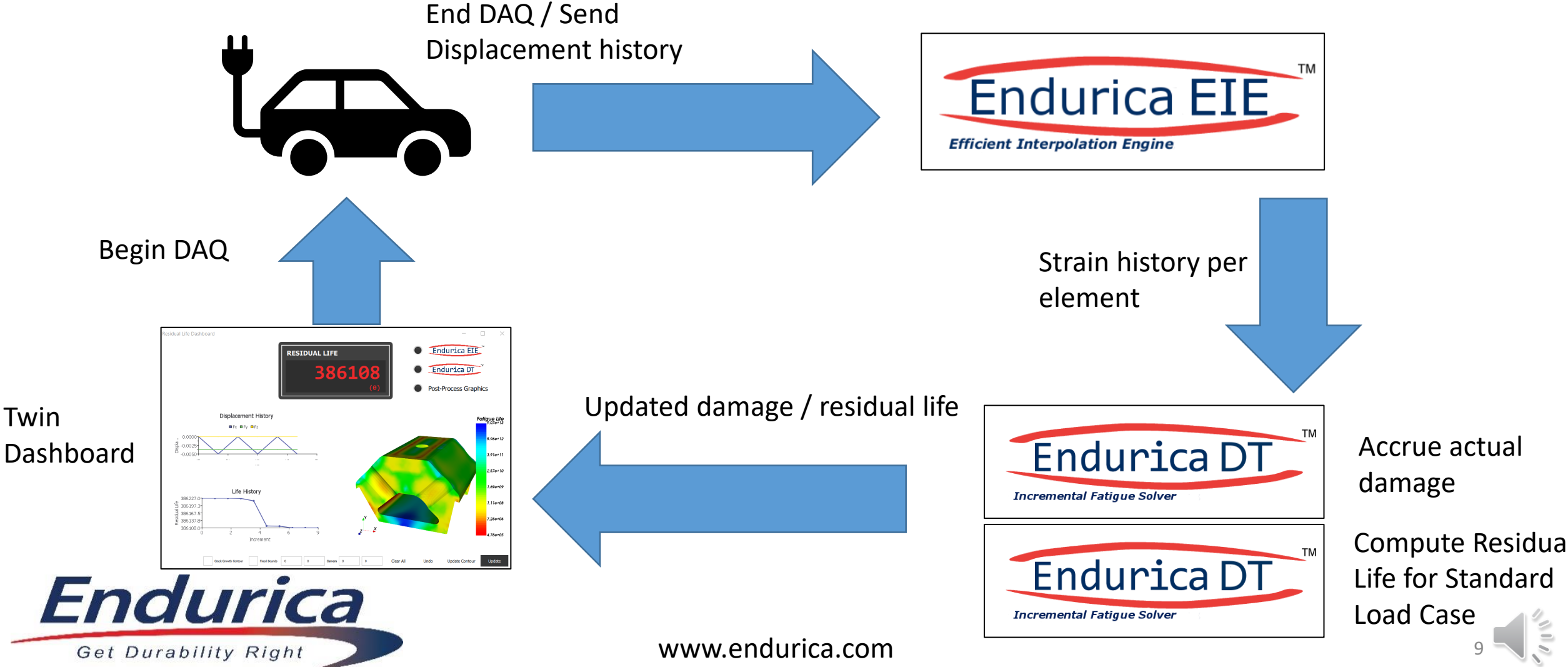
Critical Plane Analysis
Planes = 17



Standard Load Case:
 $dx = dz = 0 \text{ mm}$
 $dy = -3.75 \text{ mm}$

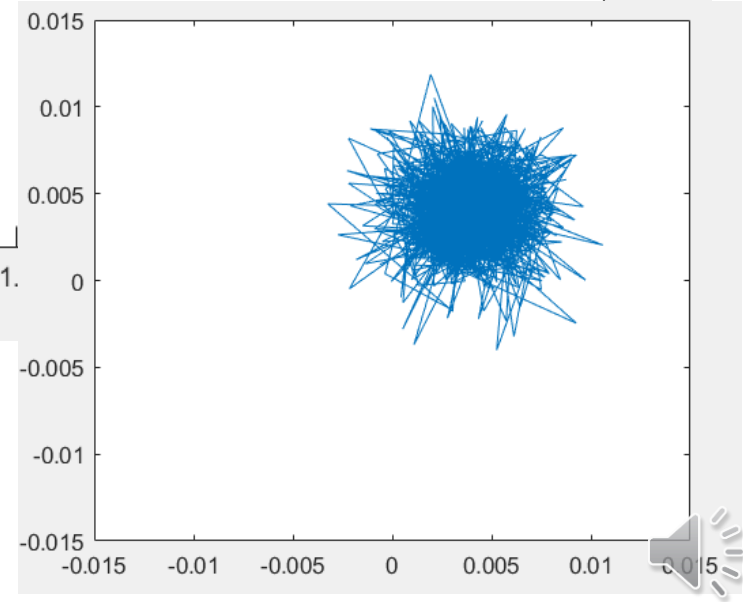
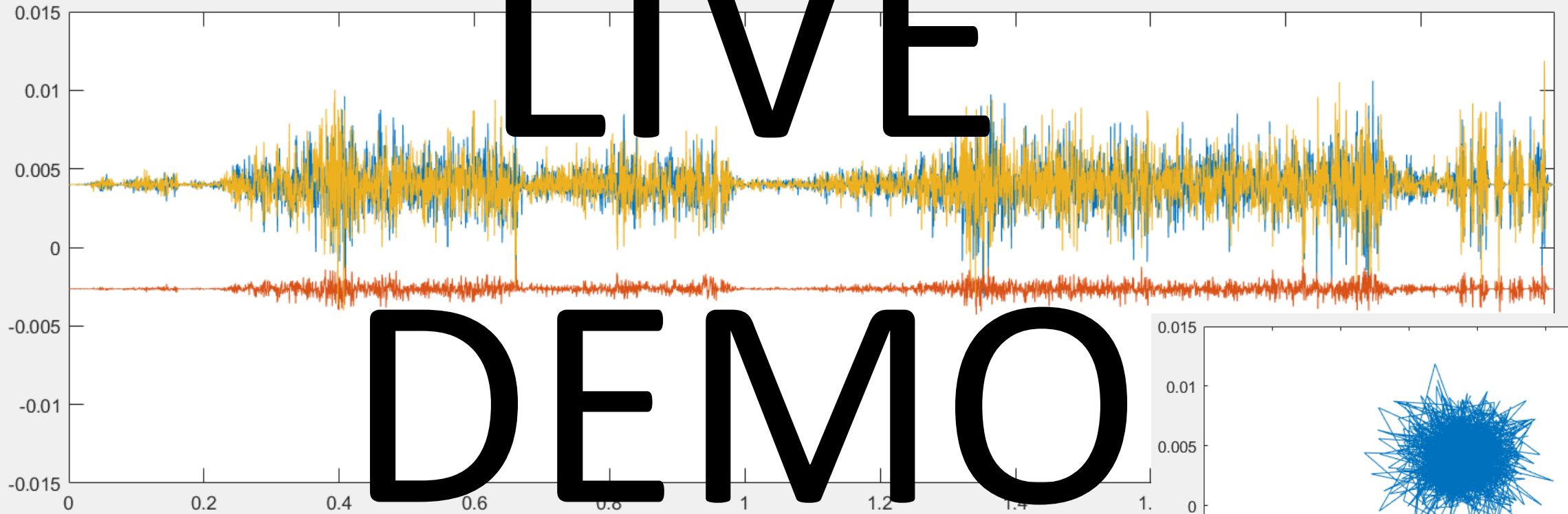
$N_f = 386227$ repeats

Digital Twin Update Workflow



LIVE

DEMO



Conclusion

- Works now with COTS tools!
- Digital Twin How To
 - Implementation
 - Operation
- Compute Speed
 - Currently <0.03 sec / datapoint
 - 2018-2020: 10x speedup (binary data format, partial parallelization)
 - 2020-2022: >10x speedup (full parallelization)

- #GetDurabilityRight
- #WinningOnDurability



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