UNIVERSITY OF NORTH CAROLINA CHARLOTTE | CENTER FOR PRECISION METROLOGY

Design and Evaluation of a Low Cost In-Situ 3D Vibration Sensing Array for an LPBF Recoater Arm

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What are we measuring and WHY?

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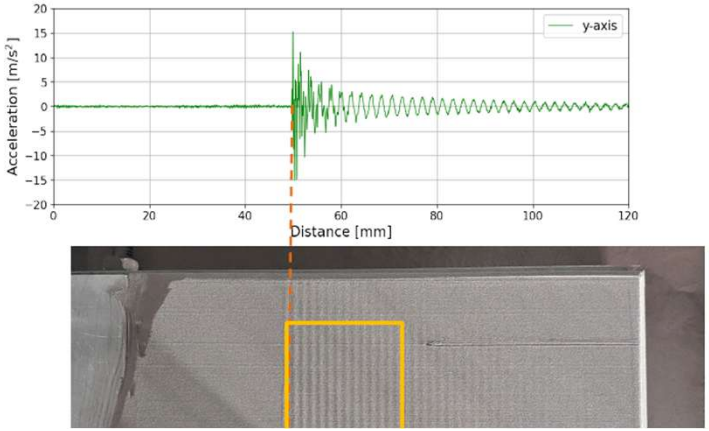
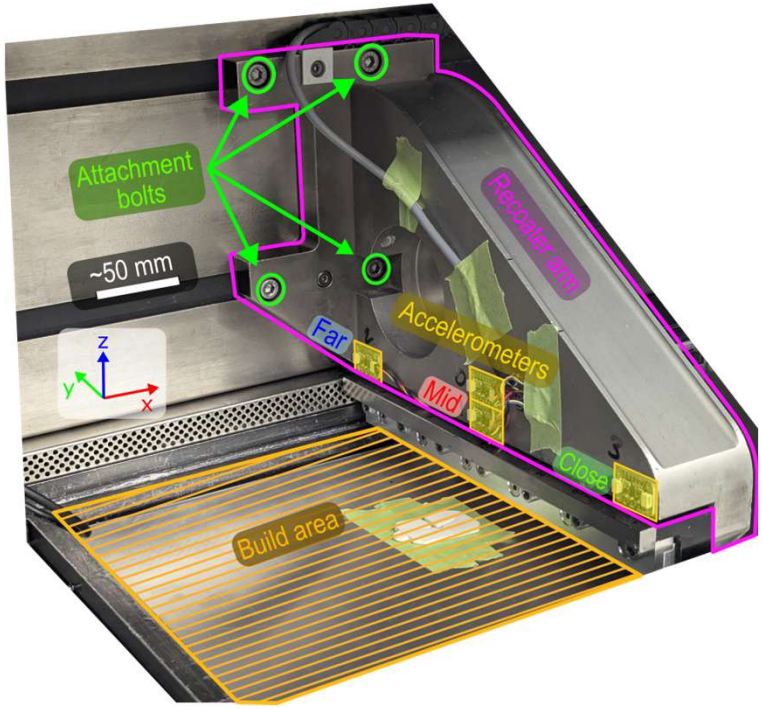
- Acceleration along the length (y-axis) of a recoater assembly within a laser powder bed fusion (LPBF) system.
- Vibrations within this subsystem can affect the surface quality of the recoated metal powder, affecting build quality.



Powder surface defects and the associated acceleration data (Adapted from Carillo, 2022)



Triaxial MEMS accelerometer array installed onto an eos M280 recoater assembly

How did you measure that?

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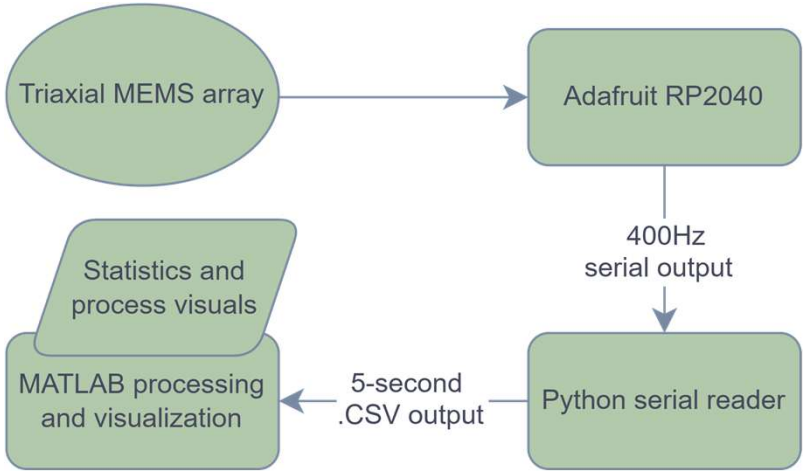
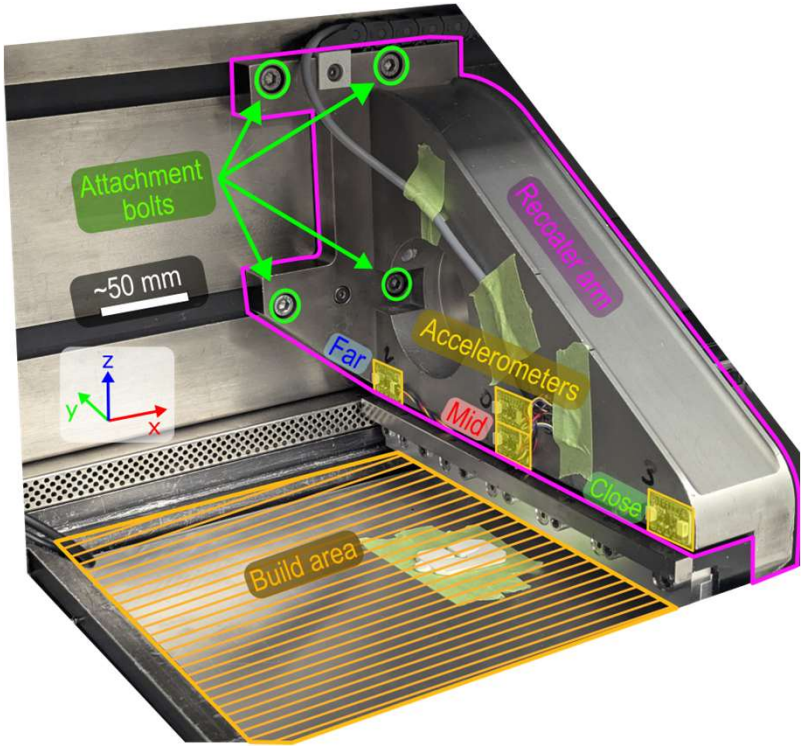
- 4 low-cost accelerometers pump bitstreams through a 4-channel multiplexer to a python code, which converts readings into a .CSV which is analyzed/visualized in MATLAB.
- MATLAB uses Butterworth band-pass with cutoffs at 5 and 100 Hz, as well as a rolling RMS filter.



Data processing flowchart



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What were the results?

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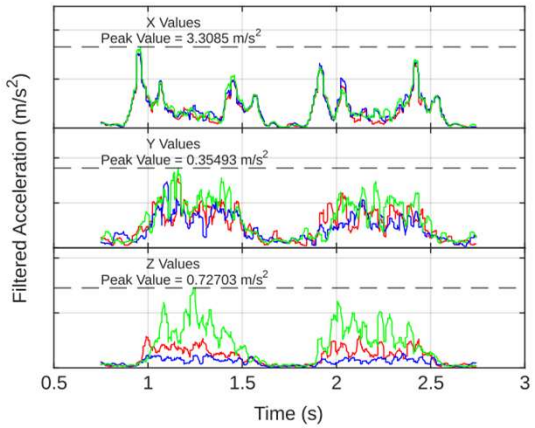
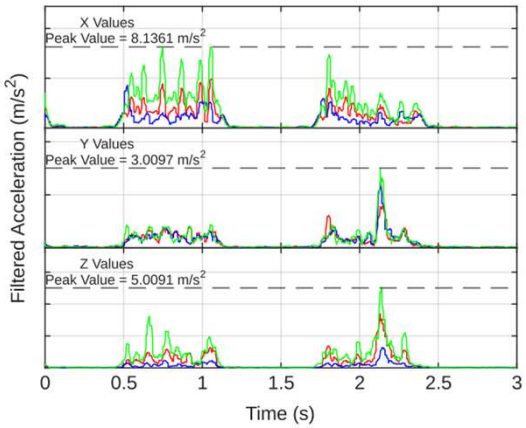
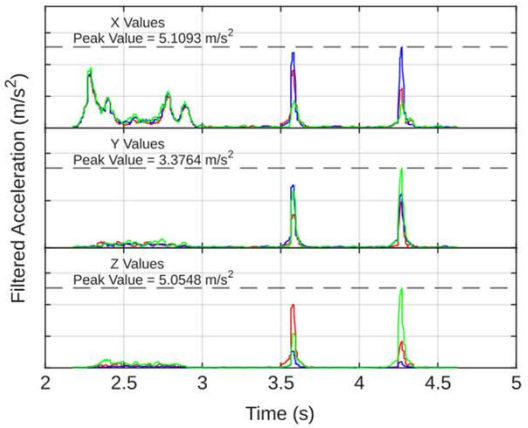
Scenario 1	Scenario 2	Scenario 3
Normal 400 mm/s jogging. 200 mm in the negative-X direction followed by 200 mm in the positive X direction. Control data	All the attachment bolts are loose, and the recoater arm is no longer rigidly attached to the motion system. 200 mm/s 100 mm jogs in either direction. Rotation = non-trending x-axis	Normal 200 mm jog at 400 mm/s followed by 2 light hammer blows to simulate a collision. Collision = high “out-of-motion-axis” acceleration and sharper spikes.







Why should we care?

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- Easily accessible technology invites widespread adoption.
- Cheap ways to save money invites widespread adoption.
- Widely used systems are more likely to be standardized.
- Standardization and qualification is good for the world.