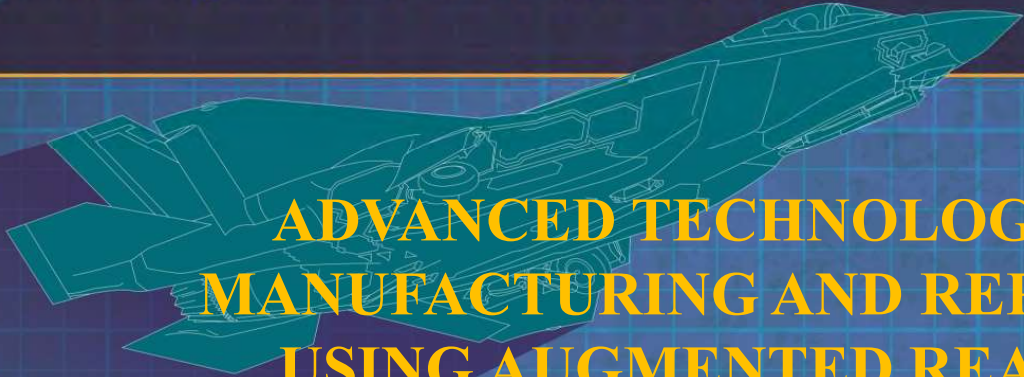


PART WORKS

Reinventing The Future Of Cold Expansion™

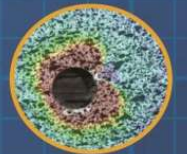
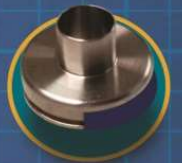
COLLABORATE WITH US
FOR EARLY ACCESS TO OUR
PATENT-PENDING* WORK



ADVANCED TECHNOLOGY MANUFACTURING AND REPAIR USING AUGMENTED REALITY

AA&S 2024
Presented by Jude Restis

PARTWORKS.COM



PART WORKS

RepAR™ Objectives

Developed as part of PartWorks' ongoing AFRL Research (2021 through 2029+)

Objectives:

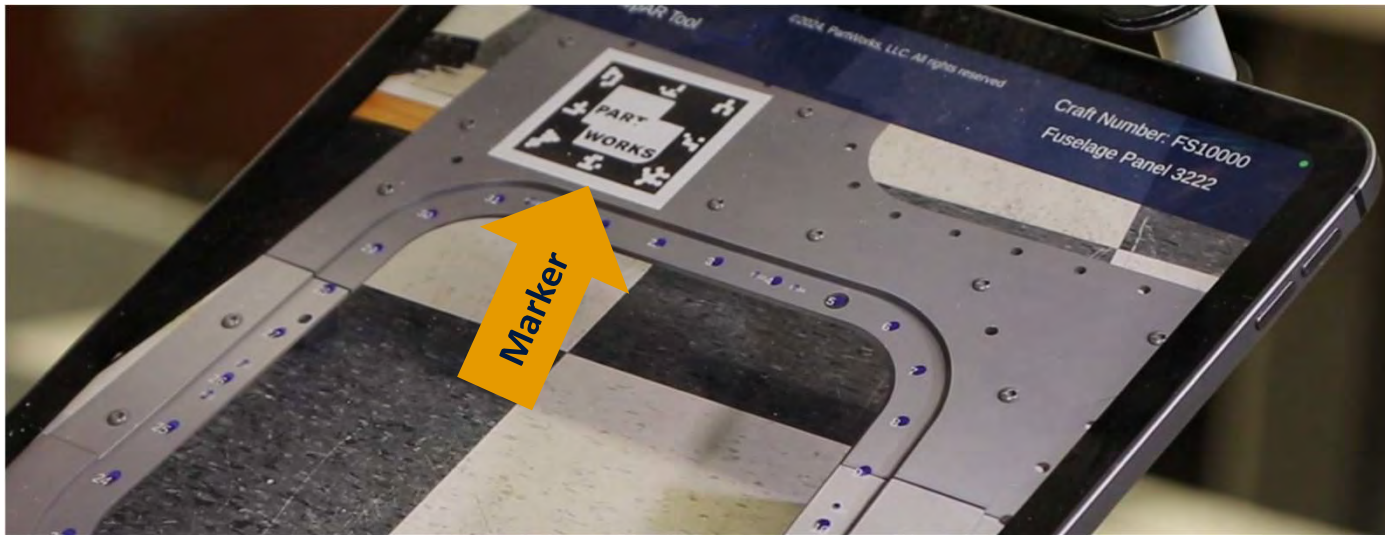
1. Provide guidance tailored to the employees' skill level.
2. Ensure that the build or repair process was completed on the correct, intended location.
3. Document that the build step or repair was completed correctly as intended at the correct hole/location.
example: document cold expansion to get life extension credit for engineering residual stress (ERS) to increase the fatigue life of the repaired structure.

What is Augmented Reality (AR)?

AR overlays digital content onto the real world in real-time, enhancing the user's perception of their environment.



How RepAR™ Works: Marker-Based



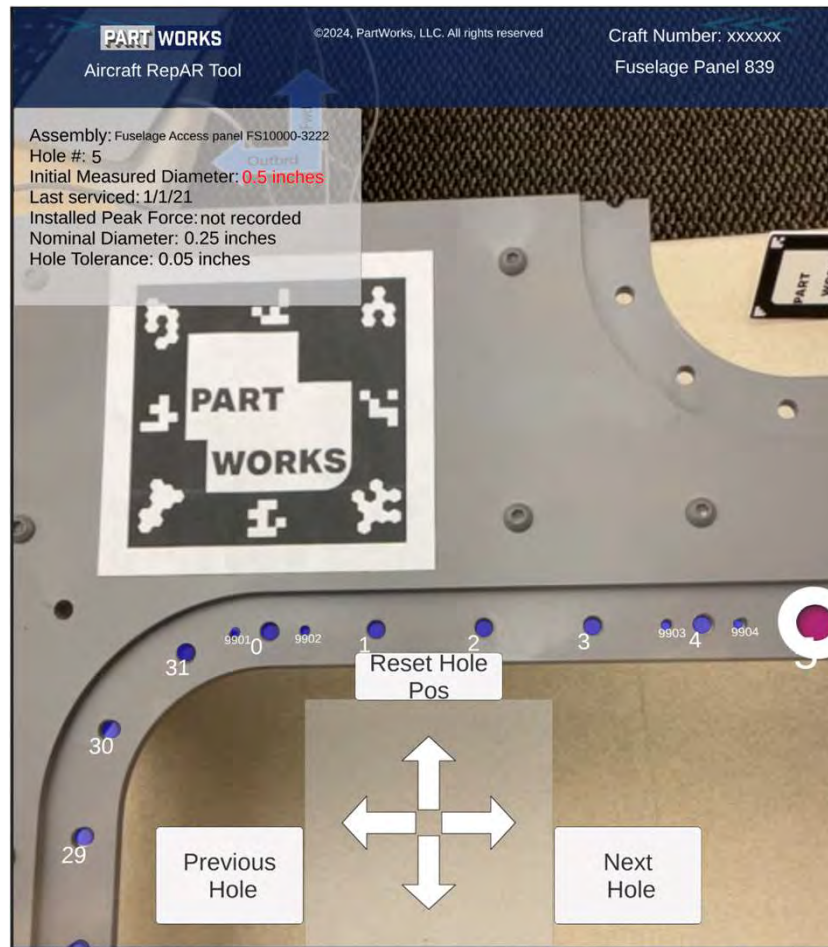
Advantages of Markers

- Works with low cost cameras, not expensive lasers or GPS
- Accurate, distance based on size
- No calibration needed, even when shaken or moved
- Print yourself, easily remove when finished

How RepAR™ Works: Technician Paints Areas of Interest



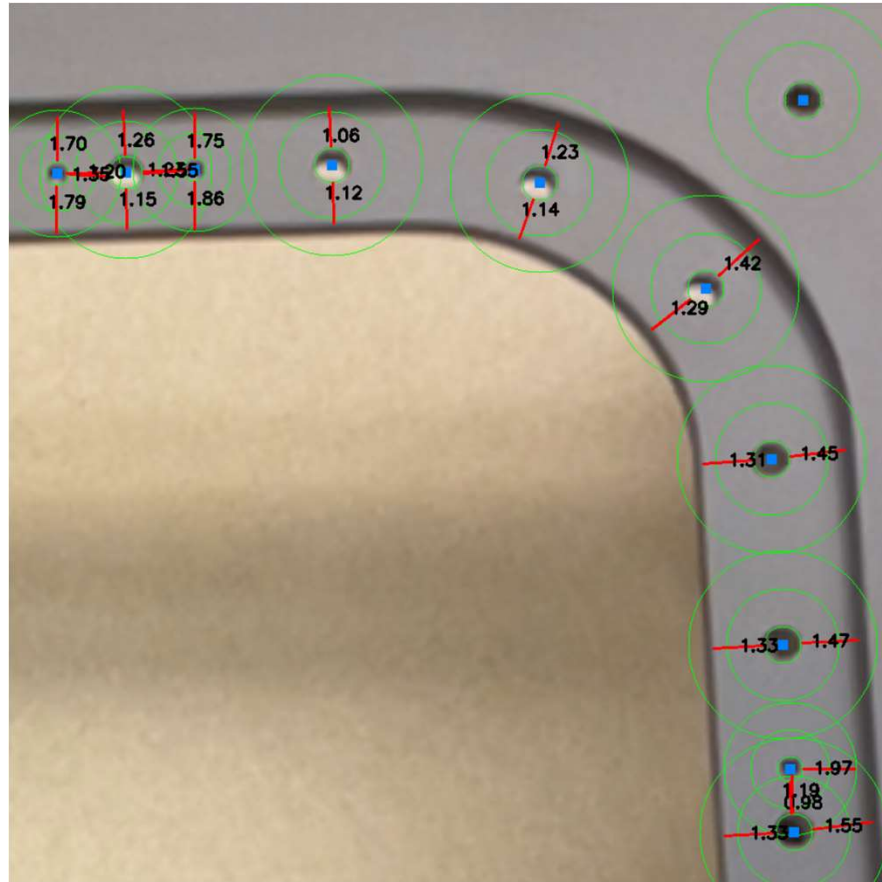
How RepAR™ Works: Holes Auto-Identified



How RepAR™ Works: Measure Diameters to 0.001"

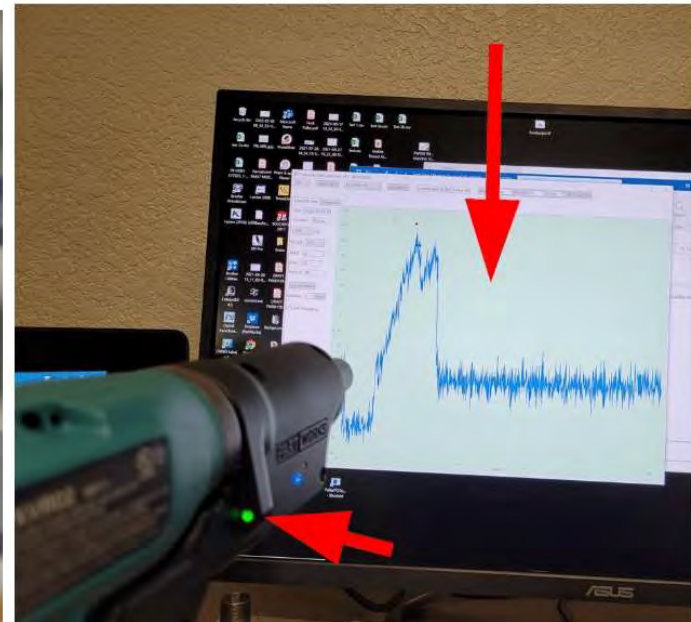


How RepAR™ Works: Measure Pitch and Edge Distance



Automatically Measures Hole-Hole and Edge Distances

How RepAR™ Works: Tool Integration for Process Control



**RepAR™ shines with Tools that have Integrated
Process Control Electronics**

How RepAR™ Works: Reduce Part Selection Errors



RepAR™ can prevent picking the wrong size or material fastener

How RepAR™ Works: Hole and Repair Database Integration

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Hole number X	Y	Z	Hole Size (Inches)	Service Date	Assembly	holeType	peakForce	Nominal Diameter	Hole Tolerance	Notes		
2	0	0	0	0	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
3	1	0.038	0	0	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	light rust		
4	2	0.076	0	0	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	slightly off-center		
5	3	0.114	0	0	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
6	4	0.152	0	0	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
7	5	0.191	0	0	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
8	6	0.228	0	-0.005	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	rusty		
9	7	0.257	0	-0.029	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
10	8	0.267	0	-0.065	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
11	9	0.267	0	-0.103	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
12	10	0.267	0	-0.142	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
13	11	0.267	0	-0.18	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
14	12	0.267	0	-0.218	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
15	13	0.267	0	-0.256	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
16	14	0.261	0	-0.293	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
17	15	0.236	0	-0.321	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
18	16	0.199	0	-0.33	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
19	17	0.161	0	-0.33	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
20	18	0.123	0	-0.33	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
21	19	0.085	0	-0.33	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
22	20	0.047	0	-0.33	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
23	21	0.009	0	-0.33	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
24	22	-0.028	0	-0.324	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
25	23	-0.055	0	-0.298	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
26	24	-0.064	0	-0.261	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
27	25	-0.064	0	-0.223	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
28	26	-0.064	0	-0.185	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
29	27	-0.064	0	-0.147	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
30	28	-0.064	0	-0.109	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
31	29	-0.064	0	-0.071	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
32	30	-0.056	0	-0.034	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
33	31	-0.03	0	-0.007	0.25	1/1/21	Fuselage Acc Main	not recorded	0.25	0.05	None		
34	9901	-0.0125	0	0	0.135	1/1/21	Fuselage Acc Satellite	not recorded	0.125	0.02	None		
35	9902	0.0125	0	0	0.135	1/1/21	Fuselage Acc Satellite	not recorded	0.125	0.02	None		
36	9903	0.1395	0	0	0.135	1/1/21	Fuselage Acc Satellite	not recorded	0.125	0.02	None		
37	9904	0.1645	0	0	0.135	1/1/21	Fuselage Acc Satellite	not recorded	0.125	0.02	None		
38	9905	0.267	0	-0.1295	0.135	1/1/21	Fuselage Acc Satellite	not recorded	0.125	0.02	None		
39	9906	0.267	0	-0.1545	0.135	1/1/21	Fuselage Acc Satellite	not recorded	0.125	0.02	None		

- Download hole data if available prior to repair
- Upload data, photos, videos after repair
- Interactively access data to validate the repair in process
- Integration can be simple, like CSV file upload/download, or sophisticated using a REST API for real-time read/write.

The DEMO

Let's see all this in action!

PART WORKS

Aircraft RepAR Tool™

RepAR™ Technology Summary

Differences in our Approach

- Doesn't require 3D model; adds capability if one exists
- Easy set up, works with tablet, laptop, cameras
- Accepts data from USB/Wireless from instruments
- No calibration: moving/shaking is fine
- Uses off-the-shelf low-cost hardware

RepAR™ Technology Summary

Low-Cost Technologies Employed

- Augmented Reality using Unity Game Engine (Win / iOS)
- Off-the-shelf cameras with Computer Vision software
- Artificial Intelligence for hole and edge recognition

Thank You!



partworks.com

jhrestis@partworks.com