AUTOMATED RIVET INSPECTION P:11582
PROJECT SUMMARY

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Project Background

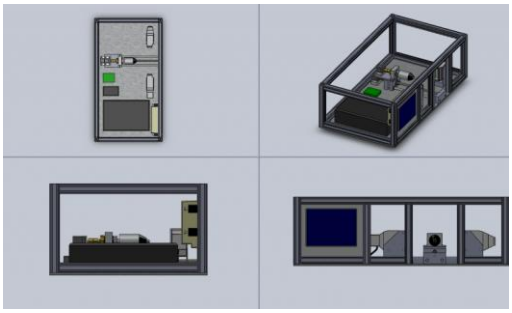
- Design and construct an inspection tool to measure and validate critical rivet dimensions at high speed in high volumes and consolidate the inspection data for use in a real time statistical control process.

Project Deliverables

- Measure all critical dimensions as specified by Cherry Aerospace
- Be efficient enough to allow up to 54 lot samples to be inspected without increasing personnel
- Be able to compare inspection data with design values
- Be highly automated
- Usable by personnel with minimal training
- Have data analysis and databasing capability
- Have a "go/no-go" indication

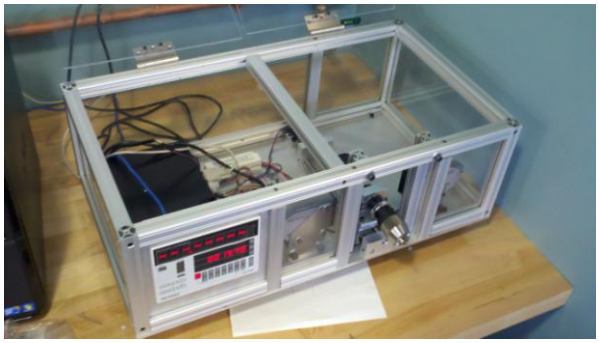
Design

- Stages
- Chuck
- Stepper Motors
- Motion Controller
- Digital Micrometer
- Additional Hardware
- Measurement Logic



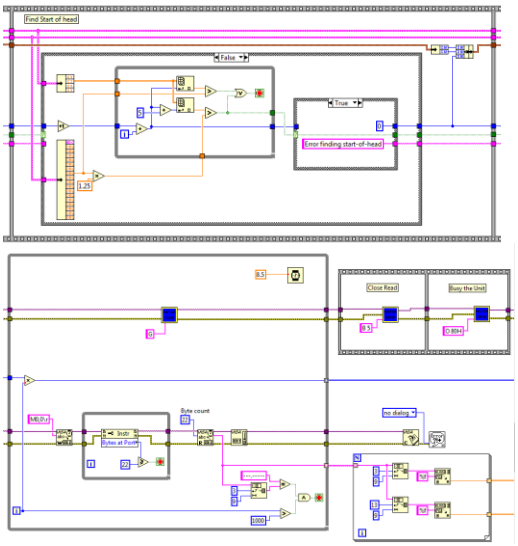
Fabrication Overview

- Linear/Rotational Stage
- Digital Micrometer Mounts
- Motor Mounts
- Arbor
- Enclosure



Programming Overview

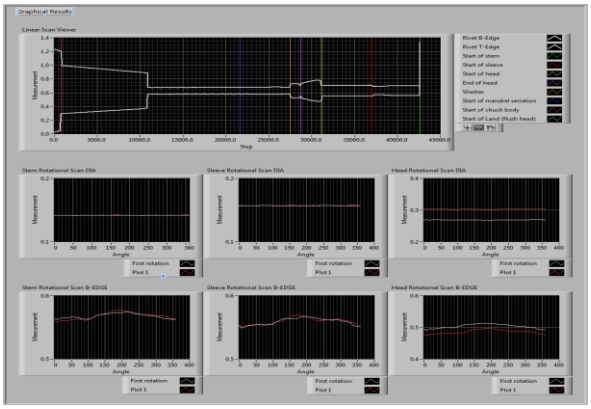
- Serial communication for stepper motor control micrometer data collection
- Custom scripts analyze data and determine pass/fail of part, allow for databasing
- Sequences
- Data analysis



Data Analysis

Feature	Trigger	Error Conditions
Start of stem	$D_i > 0$	$D_i > \text{Ddia}_{max}$
Start of sleeve	$D_i > \text{Ddia}_{min}$	$D_i > 1.1 \times \text{Ddia}_{max}$
Start of head	$D_i > \text{Ddia}_{max}$	$D_i > \text{Ddia}_{max}$
Start of land	$D_i < D_{i-1}$	$i \times$ LSC x steps/scan < 0.25 x Bref $i \times$ LSC x steps/scan > 1.25 x Bref
End of head	$\lvert D_i - D_{i-5} \rvert > 0.04$	$i \times$ LSC x steps/scan > $\text{LandThickness}_{max} + 0.01$
End of washer	$\lvert D_i - D_{i-8} \rvert > 0.75 \times$ (WasherDia - MandrelDia)	$i \times$ LSC x steps/scan > HeadToMandrel Length
Start of mandrel serrations	$D_i < 0.98 \times$ MandrelDia	$i \times$ LSC x steps/scan > 1.5 x HeadToMandrel Length
Start of chuck bodies	$D_i > 0.75$	$i \times$ LSC x steps/scan > 1.5 x HeadToMandrel Length

Output results



Preliminary Gauge R&R

3 parts, 3 trials, 3 operators

	A Dia	A Round	B Length	D Dia	D Round	Stem Dia	Stem Round	L Length	K Length
Operator A									
X-bar	0.30721	0.005947	0.076674	0.156799	0.001313	0.140637	0.00348222	0.18197	0.360119
R-bar	0.001033	0.00495	0.001167	0.000577	0.000833	0.003857	0.00441	0.00116	0.0005
Operator B									
X-bar	0.307353	0.004969	0.075787	0.1569	0.0009	0.141132	0.00216	0.18274	0.360727
R-bar	0.00133	0.00409	0.001163	0.000383	0.00048	0.001023	0.00189667	0.00066	0.000827
Operator C									
X-bar	0.306741	0.005166	0.076951	0.156987	0.000869	0.139836	0.00465444	0.18219	0.359841
R-bar	0.001587	0.00579	0.001663	0.000283	0.000417	0.00267	0.0054	0.00199	0.000833

Comparison to manual measurement

	A Dia	B Length	D Dia	Stem Dia	L Length	K Length
Part 1						
Rivetron	0.30643	0.07634	0.15691	0.14050	0.18280	0.36305
Comparitor	0.3078	0.0761	0.1566	0.142	0.189	0.3641
Difference	0.0014	0.0002	0.0003	0.0015	0.0062	0.0010
% Difference (%)	0.45	0.32	0.20	1.07	3.39	0.29
Part 2						
Rivetron	0.30728	0.07701	0.15686	0.13975	0.18147	0.35984
Comparitor	0.3076	0.0761	0.1576	0.143	0.1881	0.3619
Difference	0.0003	0.0009	0.0007	0.0032	0.0066	0.0021
% Difference (%)	0.10	1.18	0.47	2.32	3.65	0.57
Part 3						
Rivetron	0.30759	0.07606	0.15692	0.14135	0.18263	0.35779
Comparitor	0.3081	0.0765	0.1579	0.1424	0.1882	0.3591
Difference	0.0005	0.0004	0.0010	0.0010	0.0056	0.0013
% Difference (%)	0.17	0.57	0.63	0.74	3.05	0.36

Lessons Learned

- Stay in close contact with suppliers.
- Expect delays
- High precision required for motion stages
- Keep in mind communication transfer speeds
- Beware of feature creep

Special Thanks

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Questions?