DEPARTMENT OF MECHANICAL ENGINEERING

Motivation, Goal, Impact

Motivation: Diameters of power lines must be verified before expanding a power grid. Normally when verifying the lines, a bucket crew is sent out to cut power to record the diameter, which can be expensive and dangerous.

<u>Goal:</u> To create a device that can be attached to a drone and allow remote measurements of power line diameters without requiring de-energization of the lines.

<u>Impact</u>: Achieving this goal will allow power companies to quickly and efficiently measure power line diameters, and reduce costs while also keeping their workers safe.

<u>Safety:</u>

- the line
- ground

Function:

- within 0.05 inches
- 1.25 inches

Weight:

than 6 pounds

Design Calculations & Decisions

<u>Calculated</u>: Power, Fastener, Wind, Thermal, Magnetic Field, Deflection, Drop Test

Voltage	Load	Length	Power	Current	B (T) at 1	B (T) at 6	B (T) at 6
(kV)	(MVA)	(miles)	Factor	(amps)	inch	inches	feet
13	9	3	0.9	692.31	0.00545	0.000909	0.0000757
13	12	5	1	923.08	0.00727	0.00121	0.000110
34.5	35	10	0.9	1014.5	0.00799	0.00133	0.000111
34.5	70	20	1	2029.0	0.01598	0.00266	0.000222





• <u>Magnetic</u>: Energized lines \rightarrow Interference \circ 9E-4 > 5E-4 T Limit \rightarrow Shielding, Pair wiring

- Fastener: Largest force in worst case scenario • No functional failure \rightarrow #4-40 bolts works
- <u>Wind</u>: Deflection from 22 m/s wind forces ○ Dynamics → T = 64 N @ θ =14.4° → inf. life
- Thermal: Sun + Electronics heat minus convection \circ 60.15°C Electronics \rightarrow Heat sinks + Cooling

DFMA: Originally, the Jaw Design was made as one solid part, but proved expensive and difficult to manufacture for injection molding. The design was remade into four components, incorporating thin walls, fillets, draft angles, and more to reduce warping and providing structural stability. Mold-Flow Analysis: Flow analyses were conducted using SolidWorks to find cooling time, warping, and shrinkage for these parts. This data

was used to optimize the design further.

Team G2 **Power Line Diameter Measuring Device** Kwon An, Tyler DelRegno, Alec Jung, Eric Klezer, Evan Wahler, Zhi Zhao







Prototype

Measurement Tes					
	Measur				
1					
2					
3					
4					
5	-				
	~				
	2 3 4 5				



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Prototype & Test Results



sting: 2.143 red Diameter [in] 2.110 2.112 2.113 2.110 2.109 2.111 0.00204 0.03220 (2.109,2.113)

Device Reading: 2.110 in

Data Transmitter Range Testing:				
Trial	Measured Range [feet]			
1	468			
2	508			
3	475			
4	460			
5	490			
Average:	480			

Caliper Reading: 2.142 in

Measurement:

- Mean error: 0.0322 in
- 95% CI: (2.109,2.113) in
- Transmitter Range:
- Average: 480 ft

<u>Testing Needed:</u>

- EM interference
- Customer trials

