Utah State University Electric Snowmobile Team 2007

Presented By:
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Overview

- Advantages of an electric sled over a gas sled
- Energy requirements
- Design strategy
- Environmental concerns
- Interested markets

The Team

Pictured: Back Row (Left to right): Dr. Byard Wood, Mark Fairbanks, Daniel Plaizier, Kyle Hanson, Paul Overdiek, Sam Francis

Front Row (Left to right): James Gyllenskog, Ashley Kelly, Amanda Calder, Mat Brown, Isaac Jones

Comparison

- Advantages
  - Zero on site emissions
  - Quieter
  - Utility
- Disadvantages
  - Weight
  - Low range
- Cost is neutral because comparably priced

Background

- Last year's snowmobile
  - 9.5 miles
  - 1500 lbs load towing capacity
  - Cost effective
  - Around 1000 lbs
  - Top Speed of 35 mph

Objectives

- 12 miles continuously
- Maintain towing capacity
- Lighter weight
- Under 72 db
- Rider Comfort
- Safety
- Simplified Design for Increased Reliability

Specifications

- Chassis
  - 2005 Yamaha Vector
- Motor
  - 6 hp, 120 ft-lbs
- Batteries
  - 12-12 V Lead Acid Batteries
- Transmission
  - Direct Drive

- Weight
  - 1048 lbs
- Acceleration
  - 17 sec for 500 ft
- Top Speed
  - 28 mph
- Range
  - 12 miles

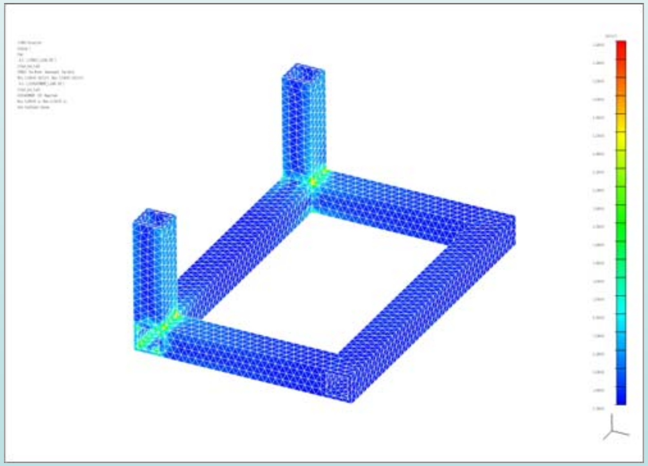
Energy Model

- Based on efficiencies of components and collected data, we optimized the configuration of the sled to achieve our goals

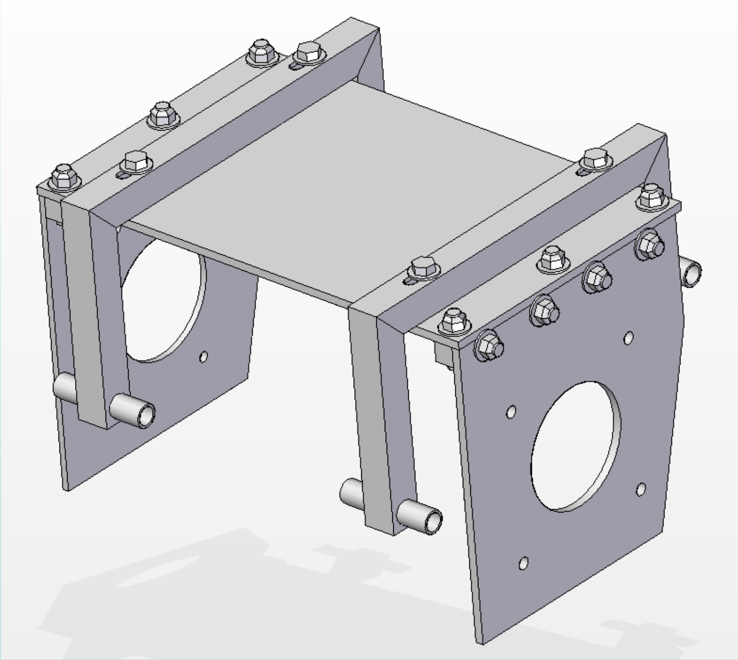
					Drag Test	Published	Batt Test	Dyno Test	
R.g=	9.3	unitless	RPM	V.mph	RR(V)	Current	n.batt	n.mot&trar	d.miles
d.equiv=	4	ft	0	0	173.74	144.3326	0.93986143	0	0
r.torque=	0.291667	ft	100	0.767742	179.452	147.1051	0.93870619	0.06928	1.371126
n.cont=	0.95	unitless	200	1.535483	185.164	149.8777	0.93755095	0.228025	4.368274
E0=	72	V	300	2.303225	190.876	152.6503	0.93639571	0.354863	6.586559
R.batt=	0.03	Ohms	400	3.070966	196.588	155.4229	0.93524047	0.454227	8.175778
n.trans=	0.97	unitless	500	3.838708	202.3	158.1954	0.93408523	0.530213	9.262545
r.sc=	1.75	unitless	600	4.606449	208.012	160.968	0.93292999	0.586579	9.953515
r.ms=	2	unitless	700	5.374191	213.724	163.7406	0.93177475	0.626748	10.33808
T.0Eng	21027600	ft*lbf	800	6.141932	219.436	166.5132	0.93061951	0.653807	10.49064
mass=	30	slugs	900	6.909674	225.148	169.2857	0.92946427	0.670503	10.47258
g=	32.2	ft^2/sec	1000	7.677415	230.86	172.0583	0.92830903	0.679251	10.33384
h=	0	ft	1100	8.445157	236.572	174.8309	0.92715379	0.682126	10.1144

Design

- Analysis was done to support the configuration decided on
  - Solid Modeling
  - FEA
  - Thermal



Battery Box FEA



Motor Mount Solid Model

Safety

- Safety
  - All battery terminals electrically insulated
  - Manual electrical connection
  - Kill switch and tether switch
  - Battery boxes are sealed and vented
  - Component containment

Reliability

- Modified suspension to handle increased weight
- Designed to troubleshoot easily
- Mostly off-the-shelf components

Utility and Rider Comfort

- Utility
  - High towing capacity
- Rider Comfort and Ergonomics
  - Battery box designed as a seat
  - Suspension modified
  - Handlebar bracket

Environmental Impacts

- National Science Foundation
  - Good for taking environmental data with no emissions from the support vehicle
- Yellowstone
  - Doesn't disrupt wildlife

http://www.riverstoneresorts.com/Images/bullelk.jpg

http://www.pulsetech.net/pulsetechnology/environment/Enviro_web.jpg

Future Improvements

- Increase Range
  - More efficient drive system
  - Reduce weight through improved structural design
  - New battery technology
- Suspension and handling
  - Improved weight distribution

Conclusion

Engineering analysis and design principles were used to build a more competitive second generation snowmobile at Utah State University.

- Increased performance by 20%
- Maintained towing capacity
- Improved aesthetic value and ergonomics
- Noticeable sound reduction