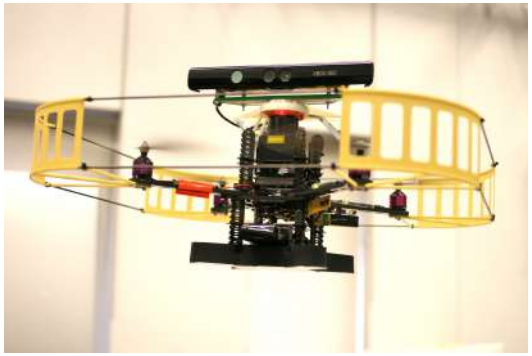
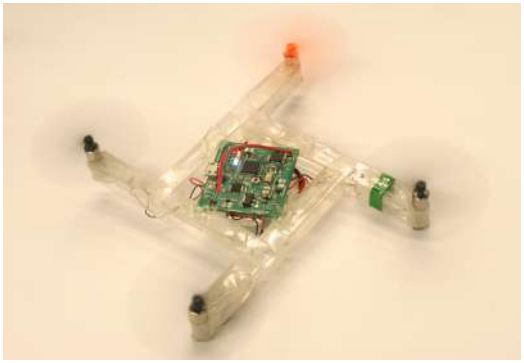
Power and Thrust

AscTec Hummingbird[1]
http://www.asctec.de/

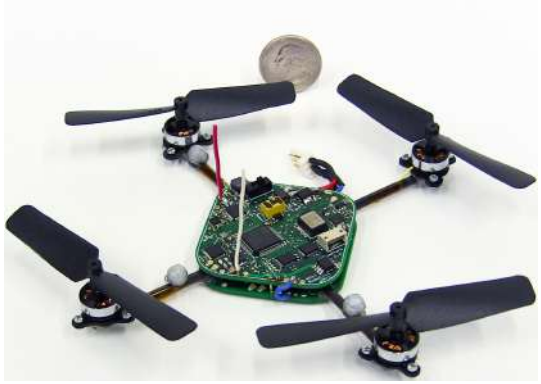
AscTec Pelican (unloaded)
http://www.asctec.de/



AscTec Pelican (loaded)[2]
http://www.asctec.de/



PPR Folded Quadrotor[3]



KMel Nano[4]

KMel kQuad 500[5]

[1]Daniel Mellinger, Nathan Michael, and Vijay Kumar. Trajectory Generation and Control for Precise Aggressive Maneuvers with Quadrotors. *International Journal of Robotics Research*, Apr. 2012.

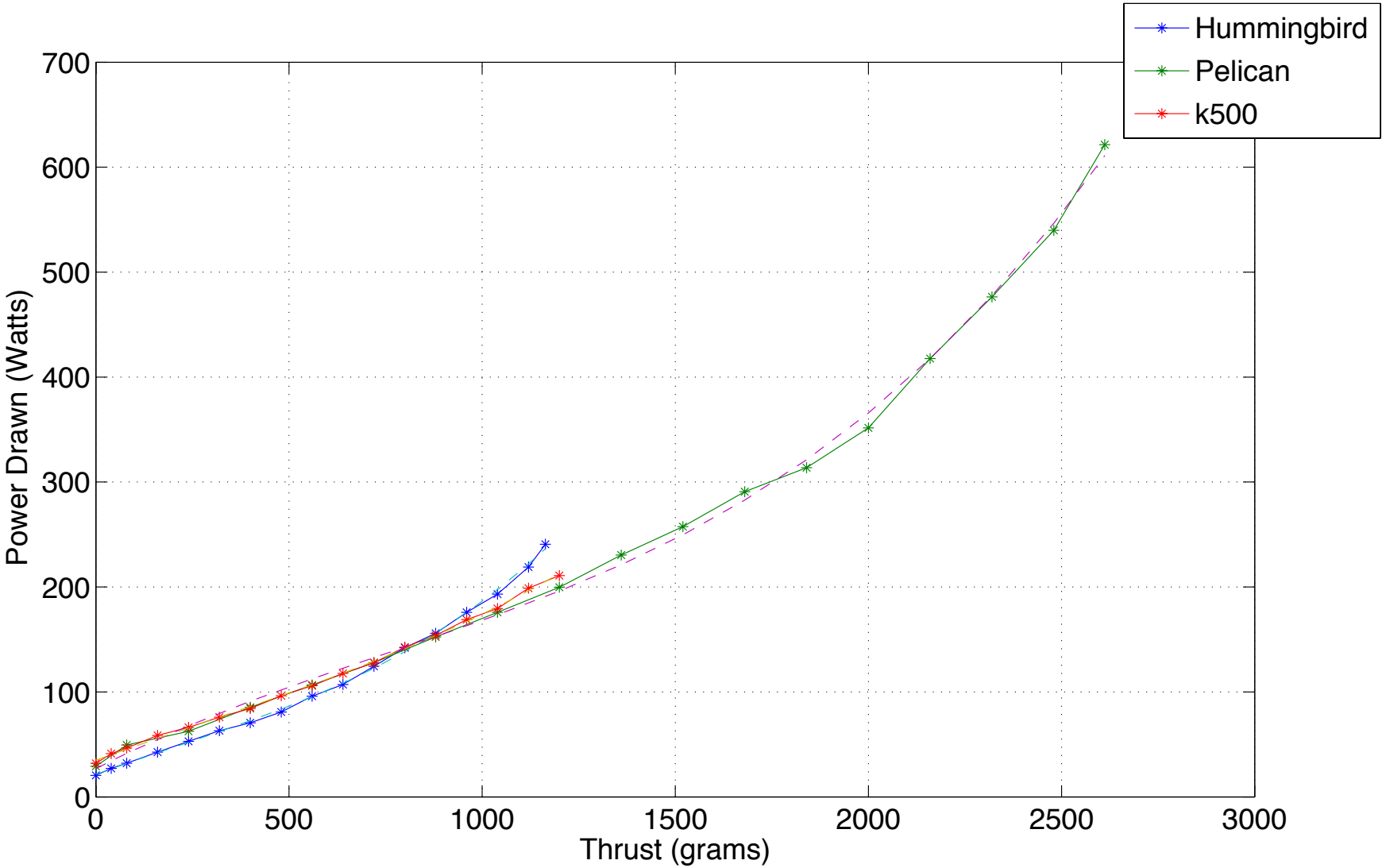
[2]S. Shen, N. Michael, and V. Kumar, "Stochastic differential equation-based exploration algorithm for autonomous indoor 3D exploration with a micro-aerial vehicle," Intl. J. Robot. Research, Vol. 31, No. 12, pp. 1431-1444, 2012.

[3]A. Mehta, D. Rus, K. Mohta, Y. Mulgaonkar, M. Piccoli, and V. Kumar, "A Scripted Printable Quadrotor: Rapid Design and Fabrication of a Folded MAV" Proc. 16th International Symposium of Robotics Research, Singapore, Dec. 2013.

[4]Aleksandr Kushleyev, Daniel Mellinger, Caitlin Powers, and Vijay Kumar, "Towards a swarm of agile micro quadrotors," *Autonomous Robots*, Vol. 35, No. 4, Pg. 287-300, 2013.

[5]K. Mohta, M. Turpin, A. Kushleyev, D. Mellinger, N. Michael, and Vijay Kumar, "QuadCloud: A Rapid Response Force with Quadrotor Teams," *International Symposium on Experimental Robotics*, Morocco, 2014

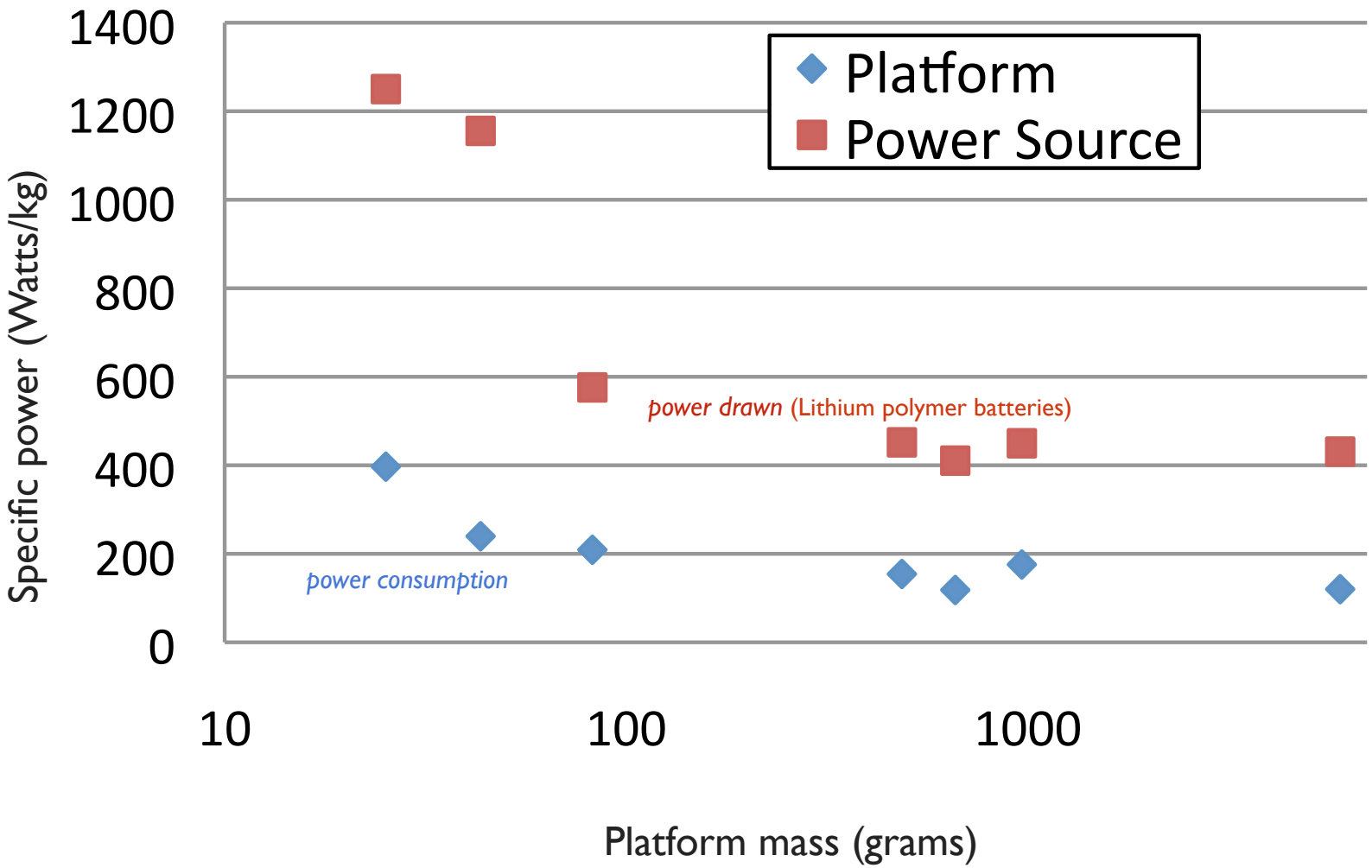
Power Consumption



Penn Engineering

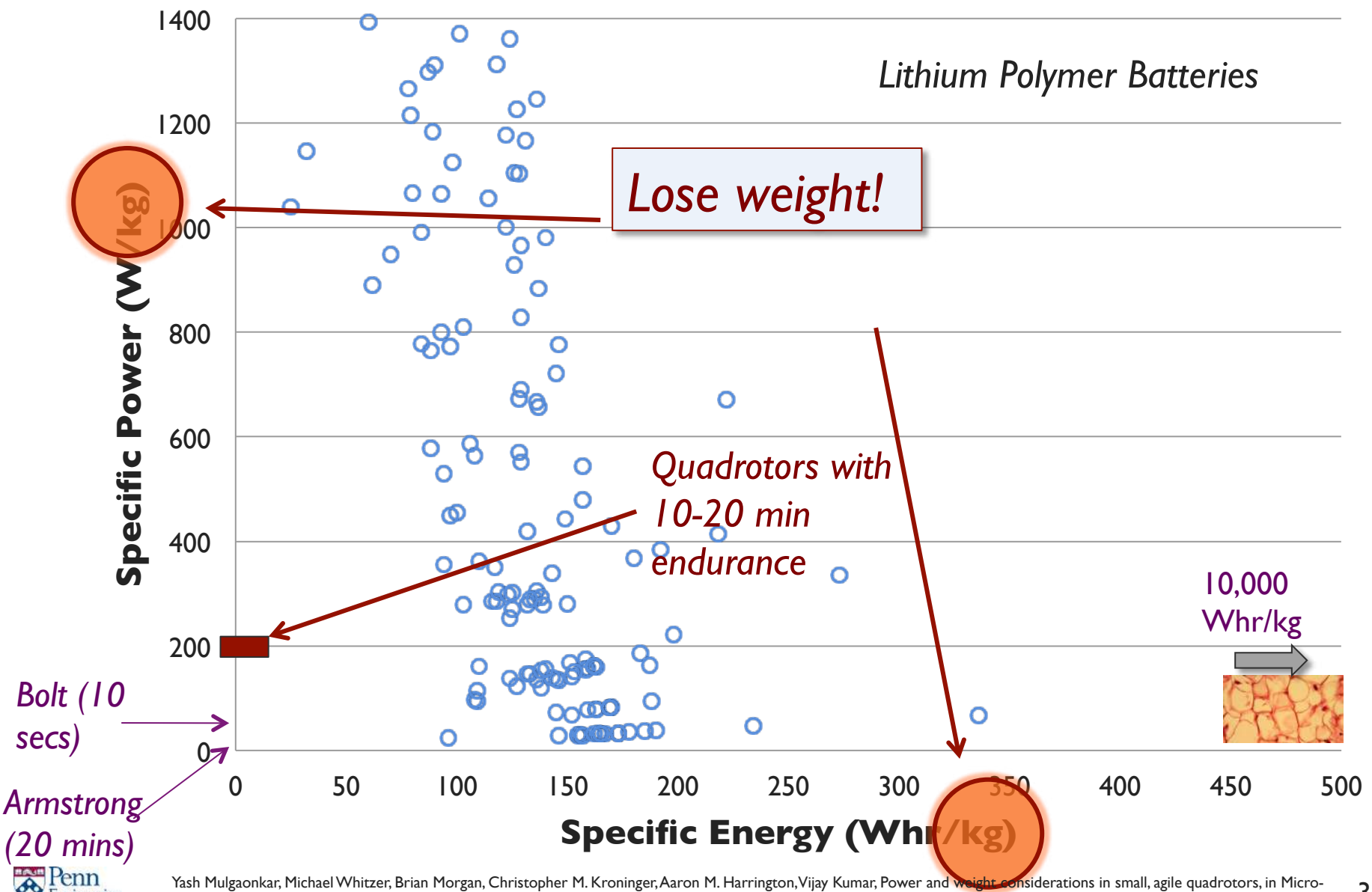
Yash Mulgaonkar, Michael Whitzer, Brian Morgan, Christopher M. Kroninger, Aaron M. Harrington, Vijay Kumar, Power and weight considerations in small, agile quadrotors, in Micro- and Nanotechnology Sensors, Systems, and Applications VI, Thomas George, M. Saif Islam; Achyut K. Dutta, Editors, Proceedings of SPIE Vol. 9083, May 2014.

Power Consumption



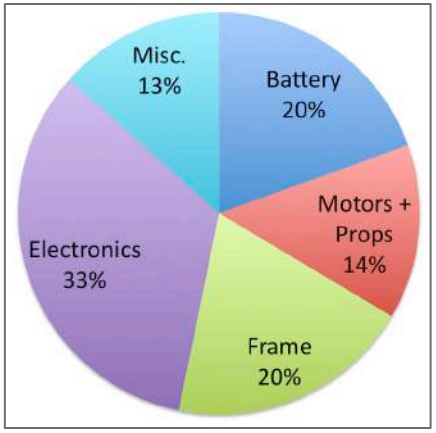
Penn Engineering

Power and Energy

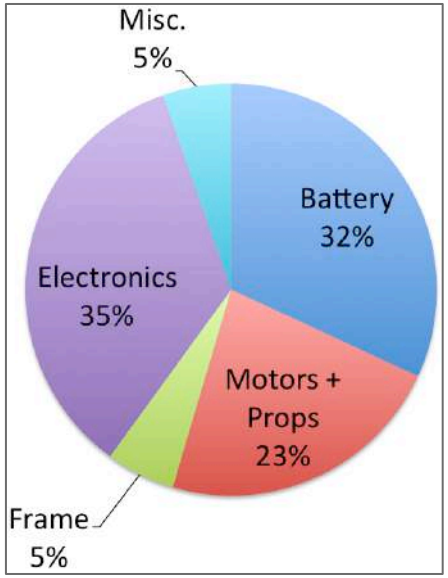


Yash Mulgaonkar, Michael Whitzer, Brian Morgan, Christopher M. Kroninger, Aaron M. Harrington, Vijay Kumar, Power and weight considerations in small, agile quadrotors, in Micro- and Nanotechnology Sensors, Systems, and Applications VI, Thomas George, M. Saif Islam; Achyut K. Dutta, Editors, Proceedings of SPIE Vol. 9083, May 2014.

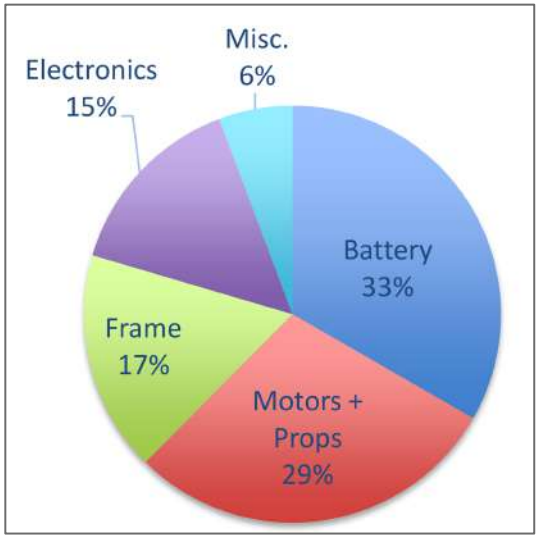
Mass Distribution



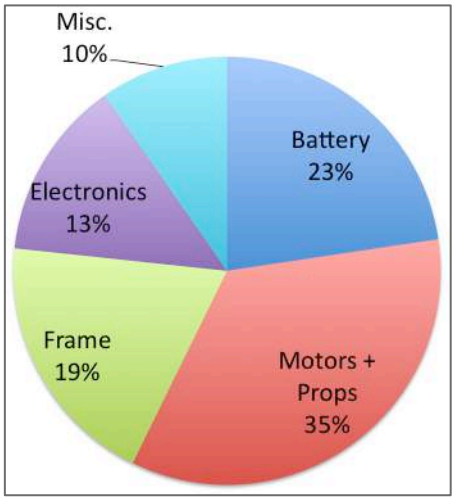
Ascending Tech.
Pelican (1937 g)



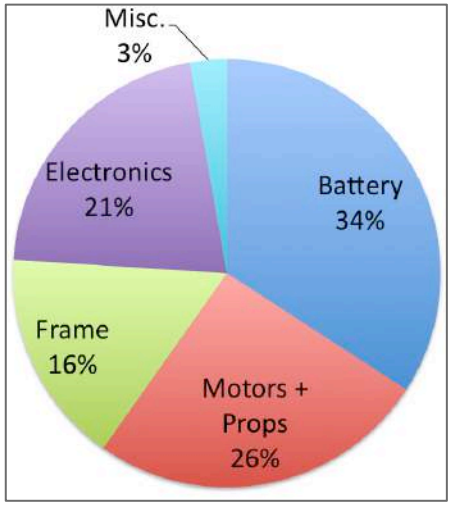
KMel Nano (82 g)



Pico



KMel kQuad (920 g)

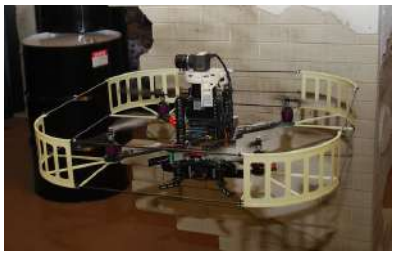


Ascending Tech.
Hummingbird (486 g)

Batteries ~ 33% mass

Motors ~ 25% mass

Sensors and Power



- Laser scanner
  - 270 gm
  - 10 W for operation plus 50-60 W for mobility
  - Range 30 m

- Cameras
  - 80 gm (including frame, each camera 25 g)
  - 1.5 W for operation plus 15 W for mobility
  - Range 10-15 m