

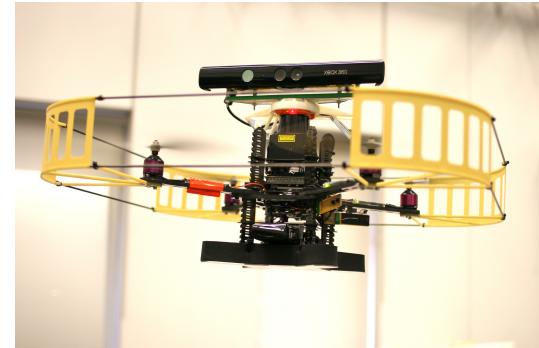
# Power and Thrust



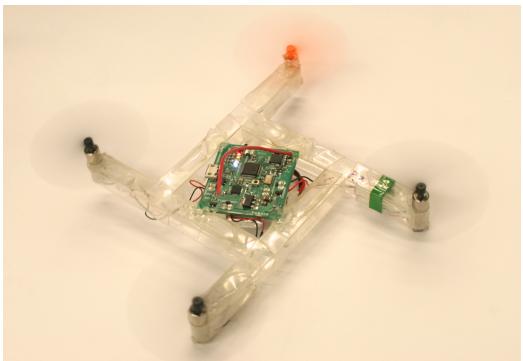
AscTec Hummingbird<sup>1</sup>  
<http://www.asctec.de/>



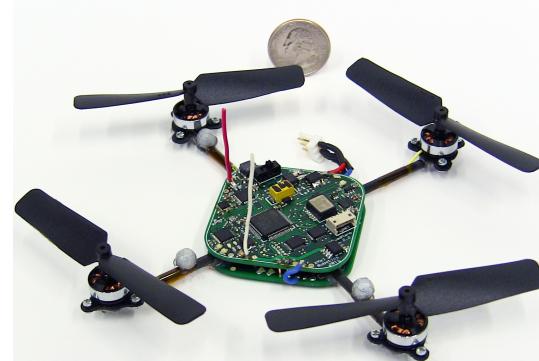
AscTec Pelican (unloaded)  
<http://www.asctec.de/>



AscTec Pelican (loaded)<sup>2</sup>  
<http://www.asctec.de/>



PPR Folded Quadrotor<sup>3</sup>



KMel Nano<sup>4</sup>



KMel kQuad 500<sup>5</sup>

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

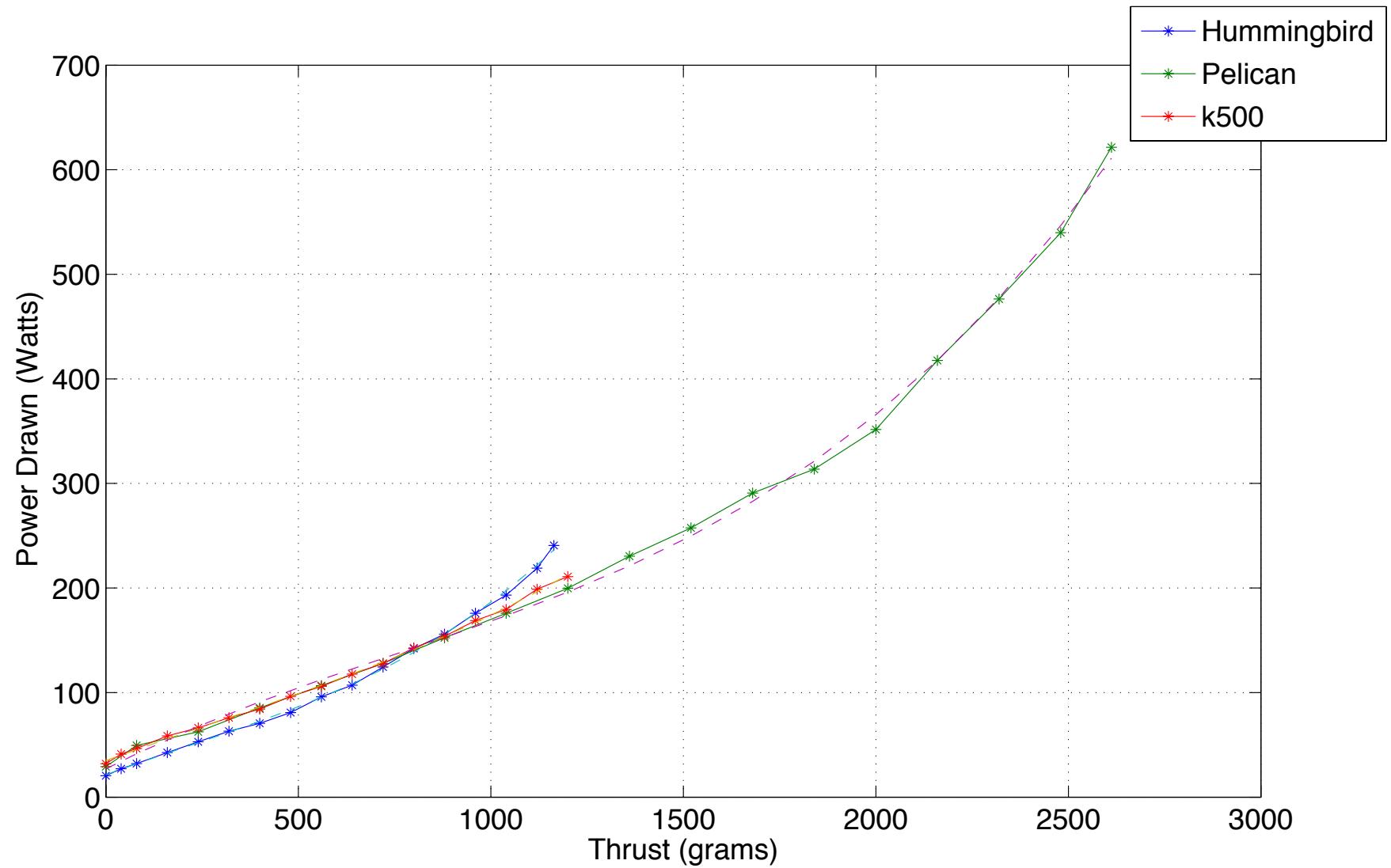
<sup>3</sup>A. Mehta, D. Rus, K. Mohta, Y. Mulgaonkar, M. Piccoli, and V. Kumar, "A Scripted Printable Quadrotor: Rapid Design and Fabrication of a Folded MAV" Proc. 16th International Symposium on Robotics Research, Singapore, Dec. 2013.

<sup>4</sup>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.

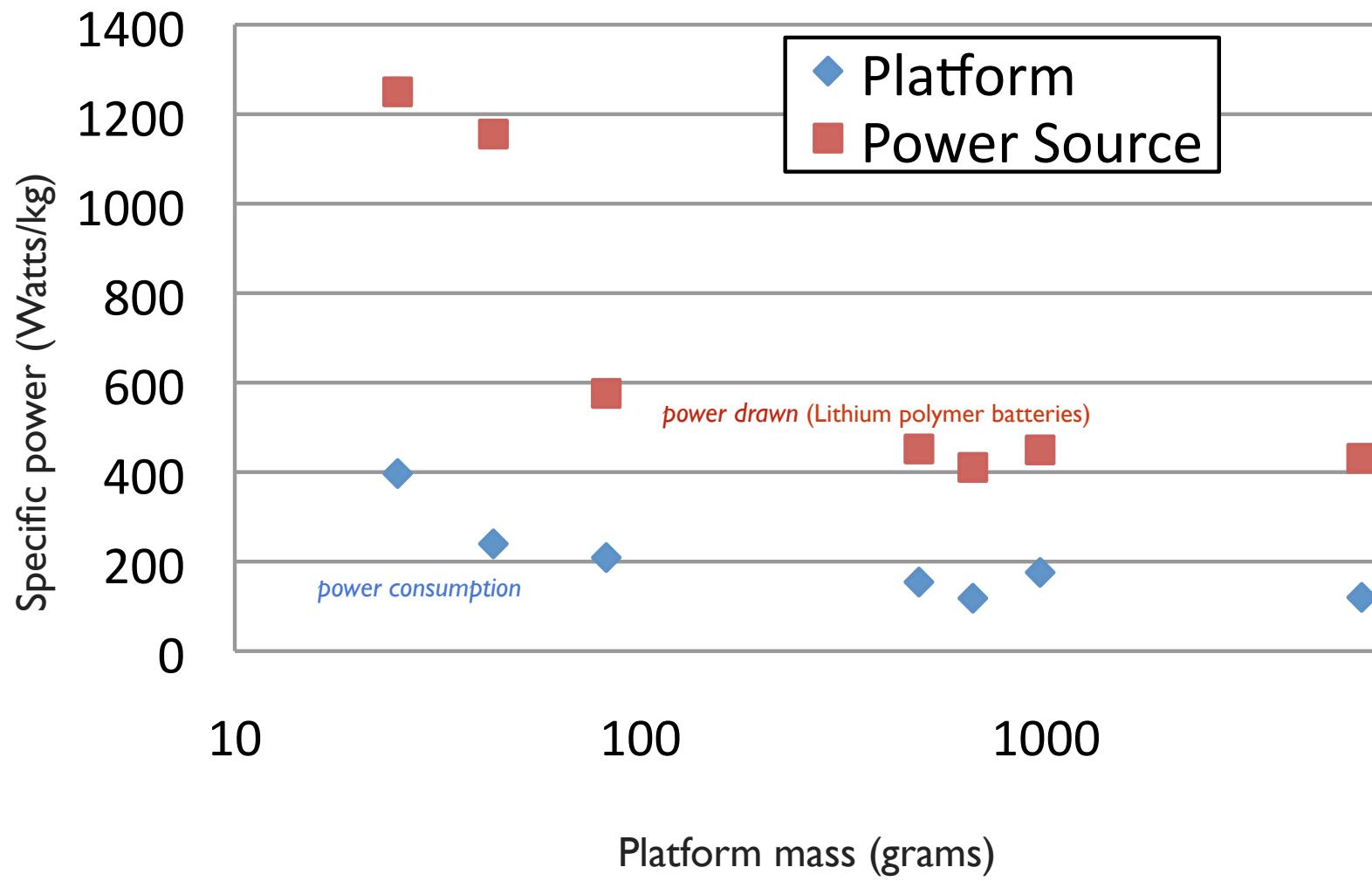
<sup>2</sup>S. Shen, N. Michael, and V. Kumar, "Stochastic differential equation-based exploration algorithm for autonomous indoor 3D exploration with a micro-air vehicle," *Intl. J. Robot. Research*, Vol. 31, No. 12, pp. 1431-1444, 2012.

<sup>5</sup>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

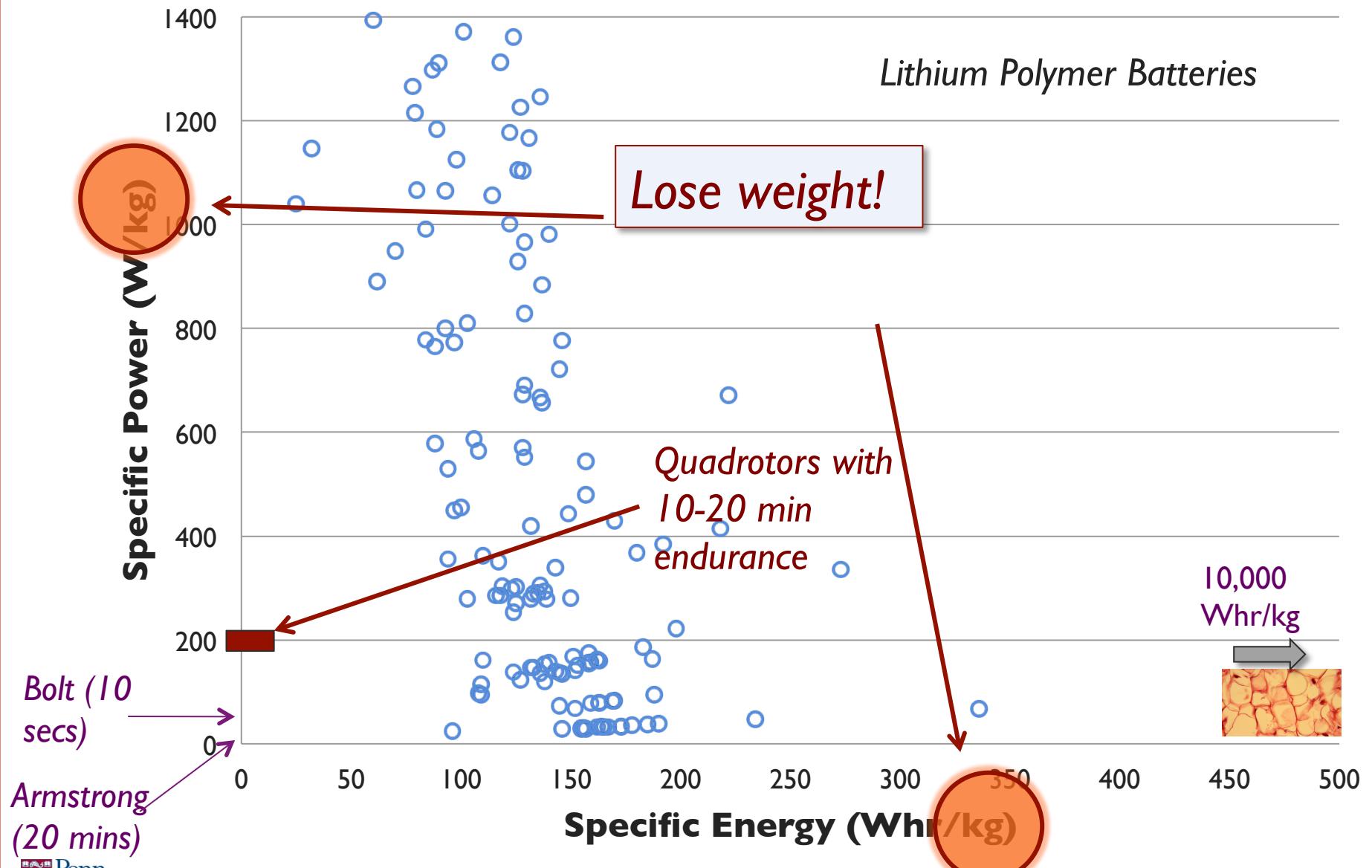
# Power Consumption



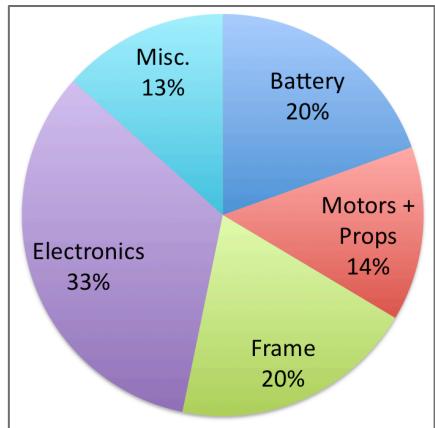
# Power Consumption



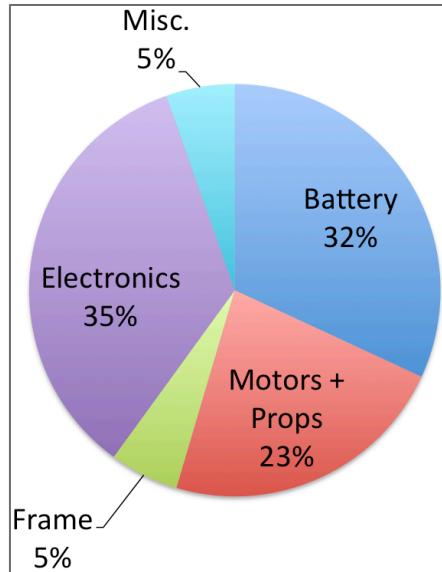
# Power and Energy



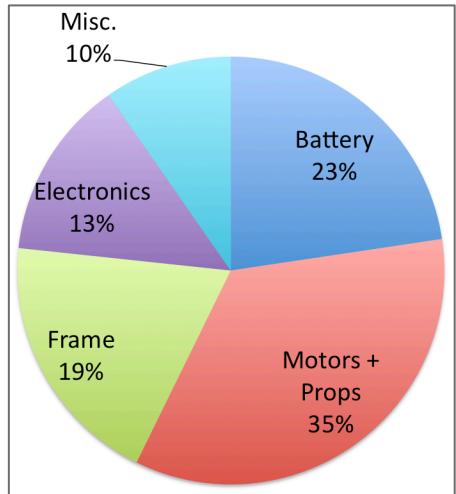
# Mass Distribution



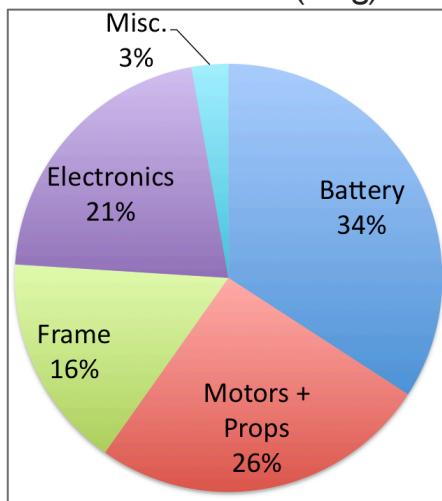
Ascending Tech.  
Pelican (1937 g)



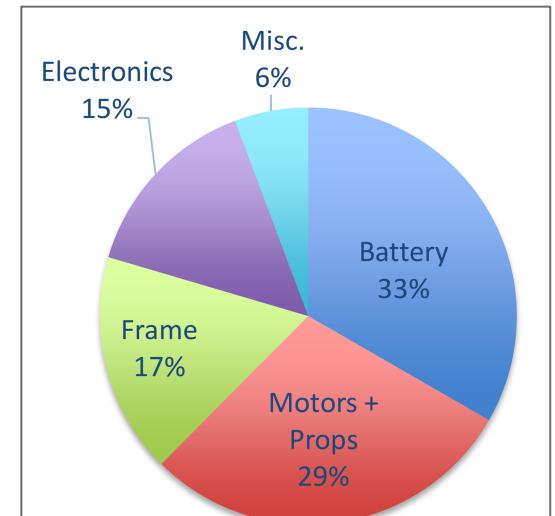
KMel Nano (82 g)



KMel kQuad (920 g)



Ascending Tech.  
Hummingbird (486 g)



Pico

Batteries ~ 33% mass  
Motors ~ 25% mass

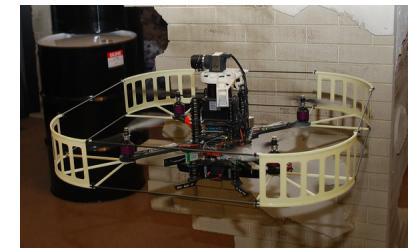
# Sensors and Power

- 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

