

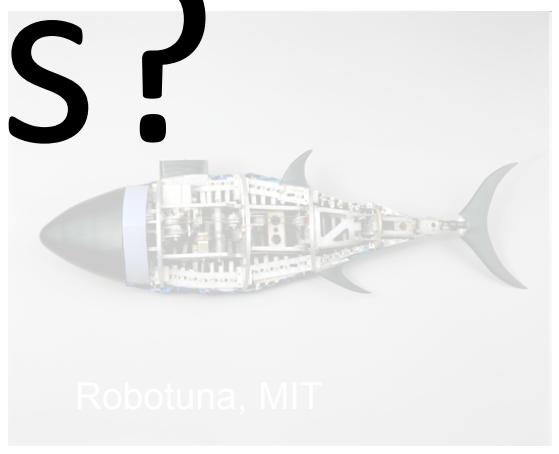


WYSS INSTITUTE
for Biologically Inspired Engineering



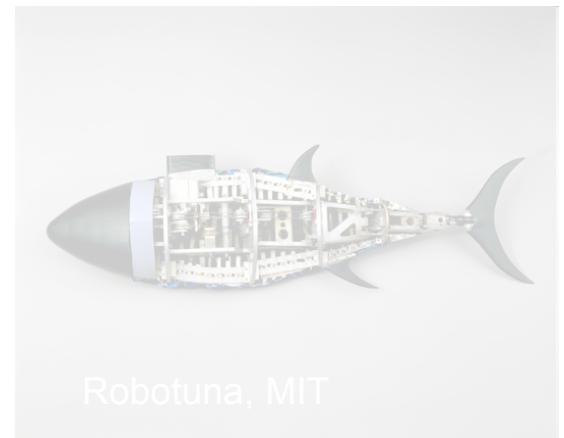
Bio-inspired Microrobotics

Ben Finio
Rebecca Kramer
Michael Petralia

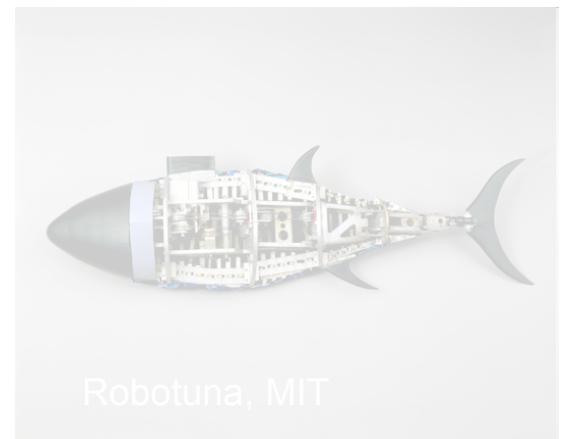
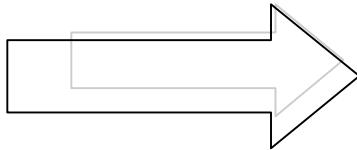
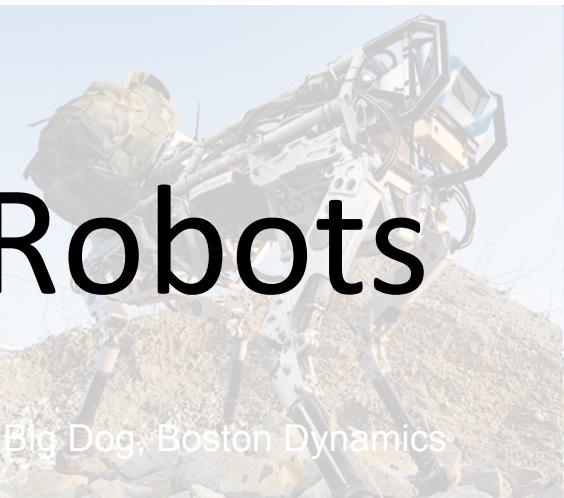


What is “bio-inspired” robotics?

Robotuna, MIT



Robotuna, MIT

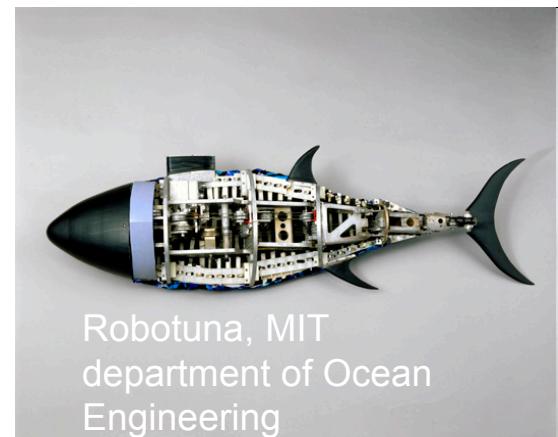
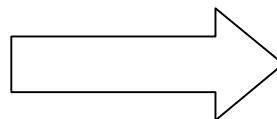
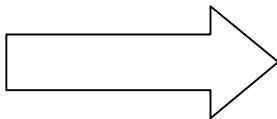
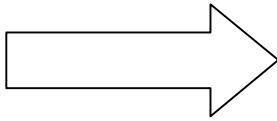


Animals

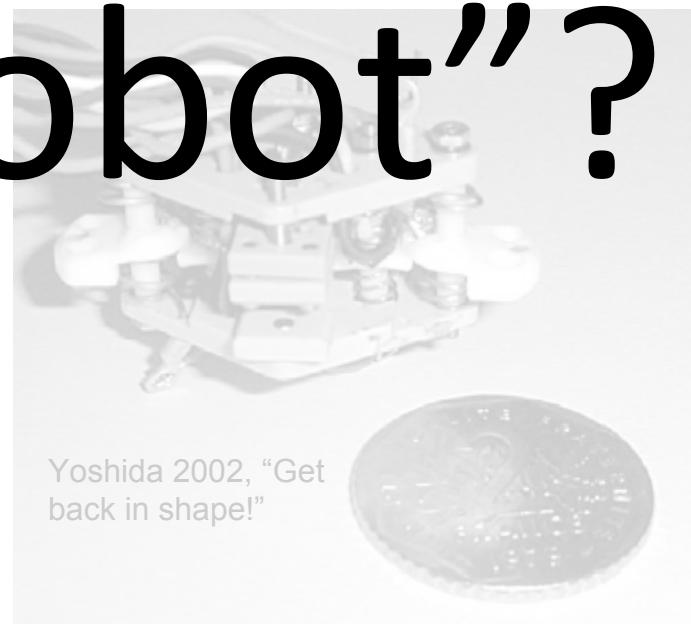
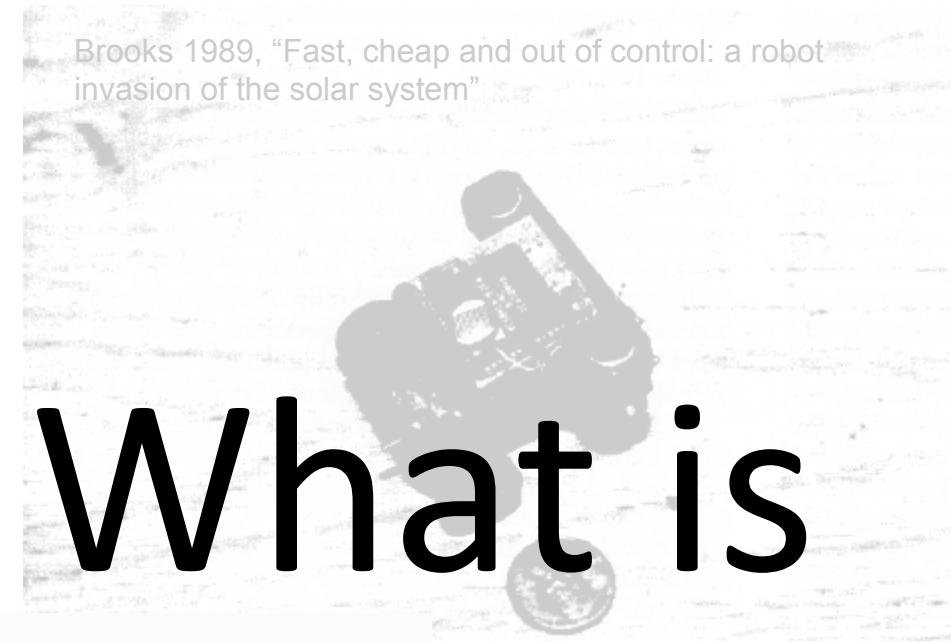
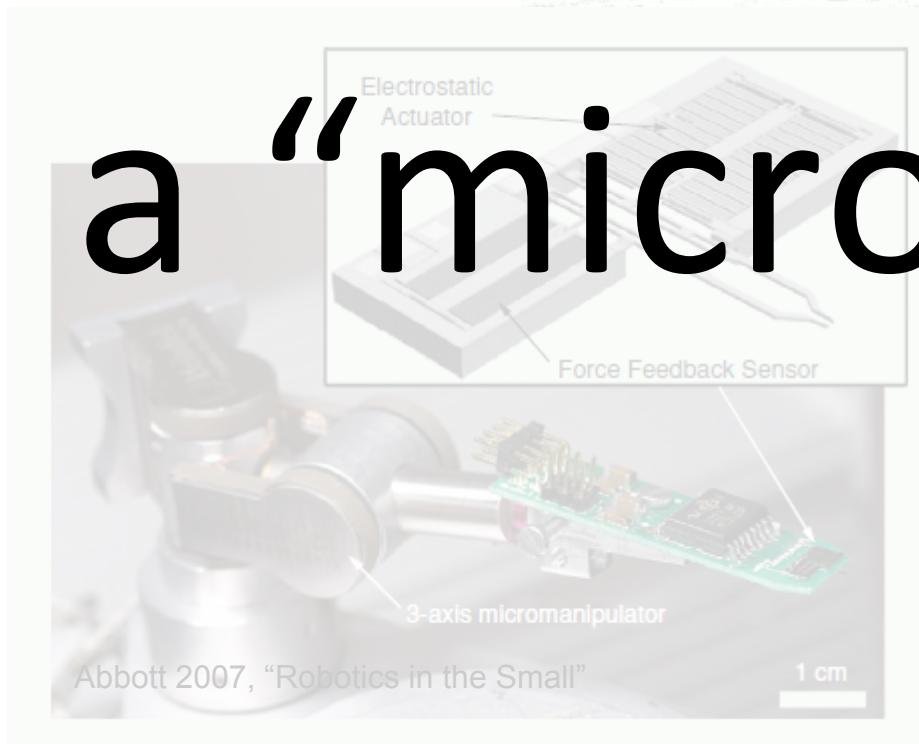
Robots

Big Dog, Boston Dynamics

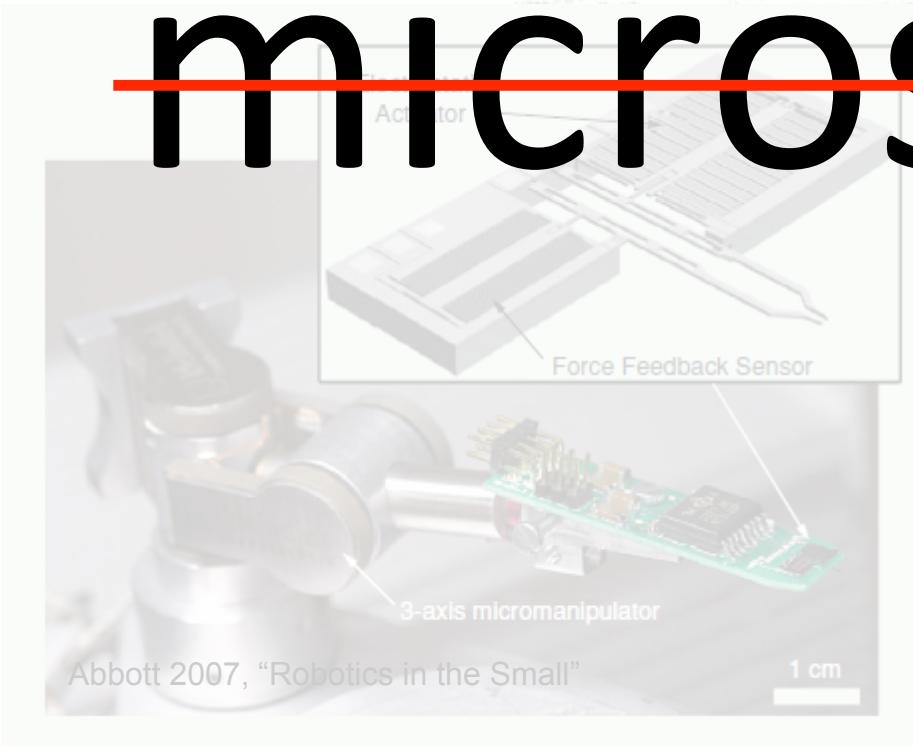
Robotuna, MIT



What is a “microrobot”?

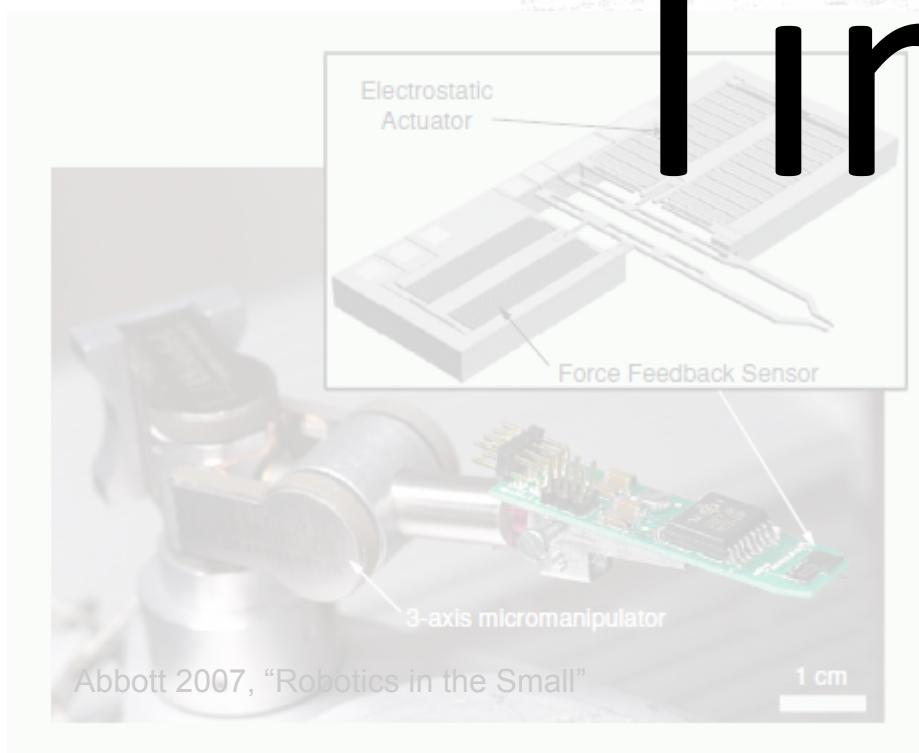


~~microscopic~~

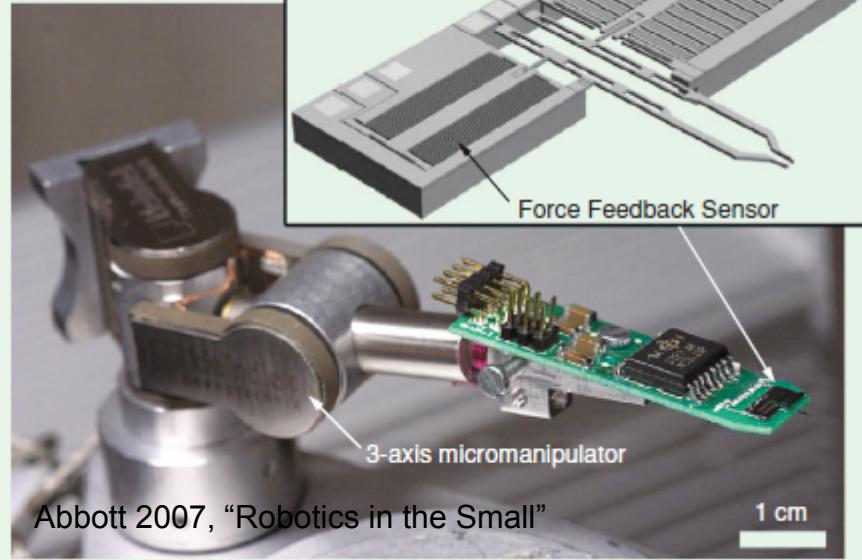
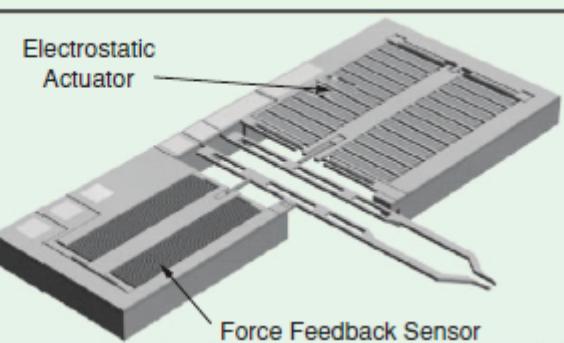
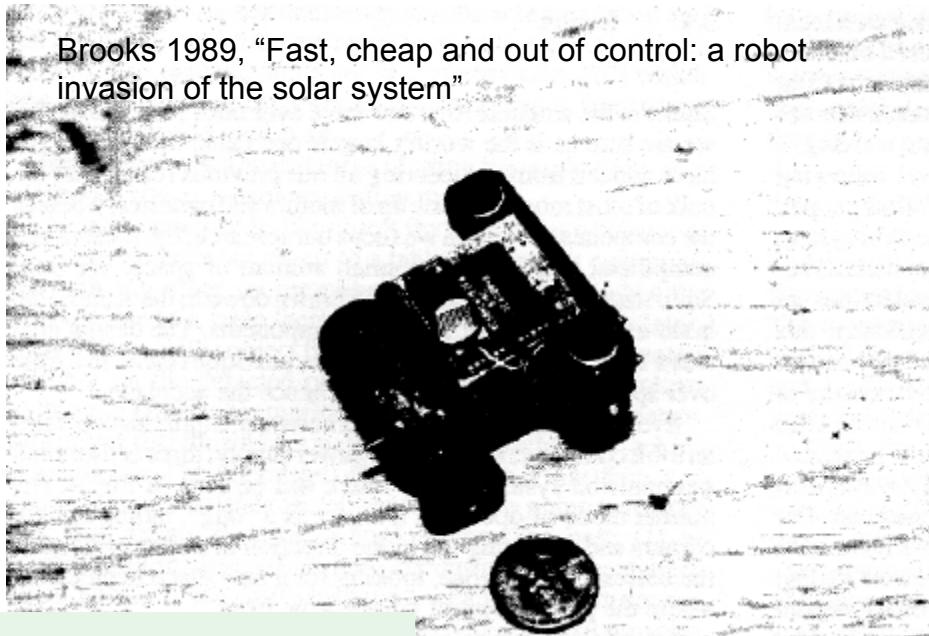


Brooks 1989, "Fast, cheap and out of control: a robot invasion of the solar system"

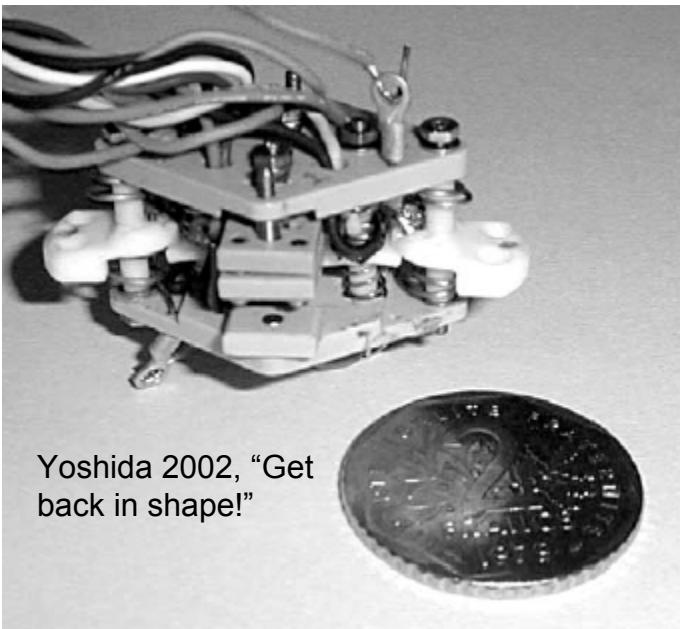
Tiny!



Brooks 1989, "Fast, cheap and out of control: a robot invasion of the solar system"

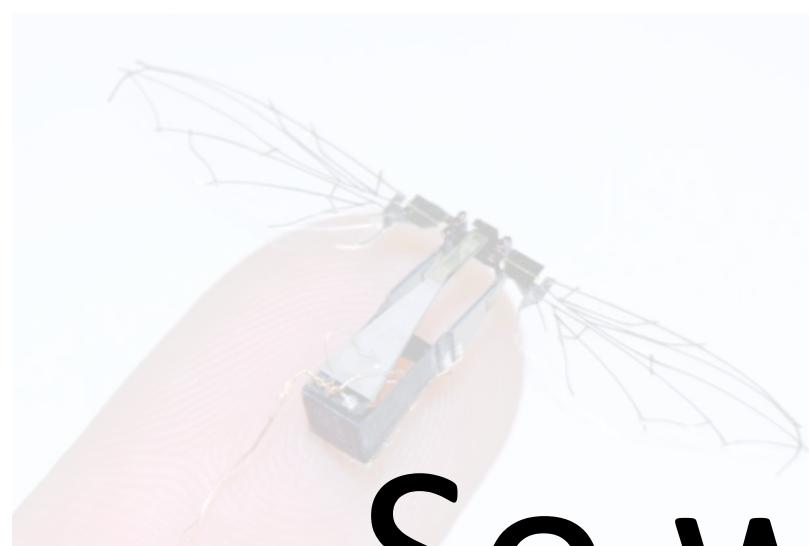


Abbott 2007, "Robotics in the Small"

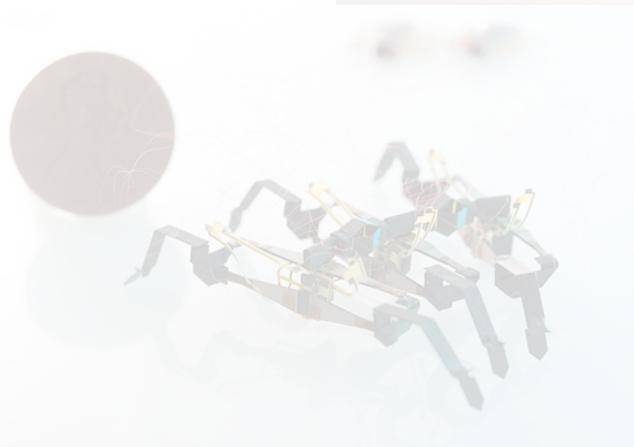
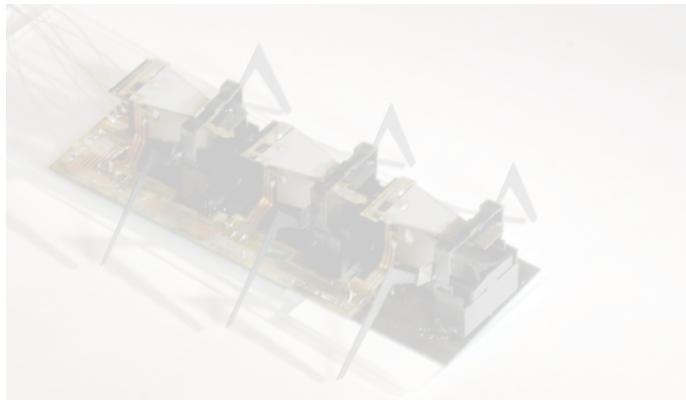


Yoshida 2002, "Get back in shape!"

So what do we do?

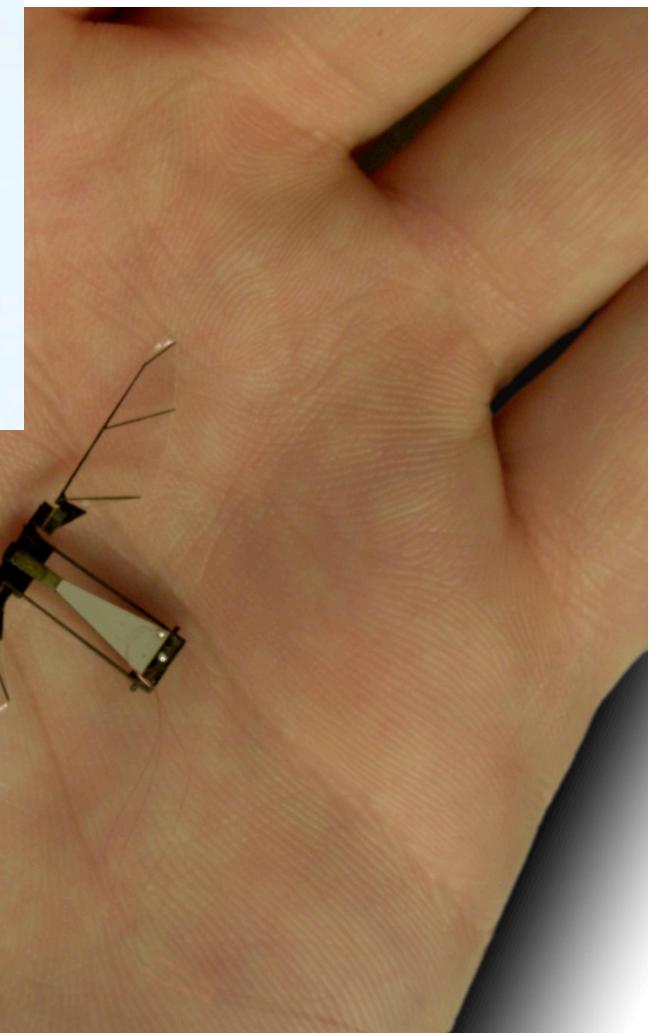
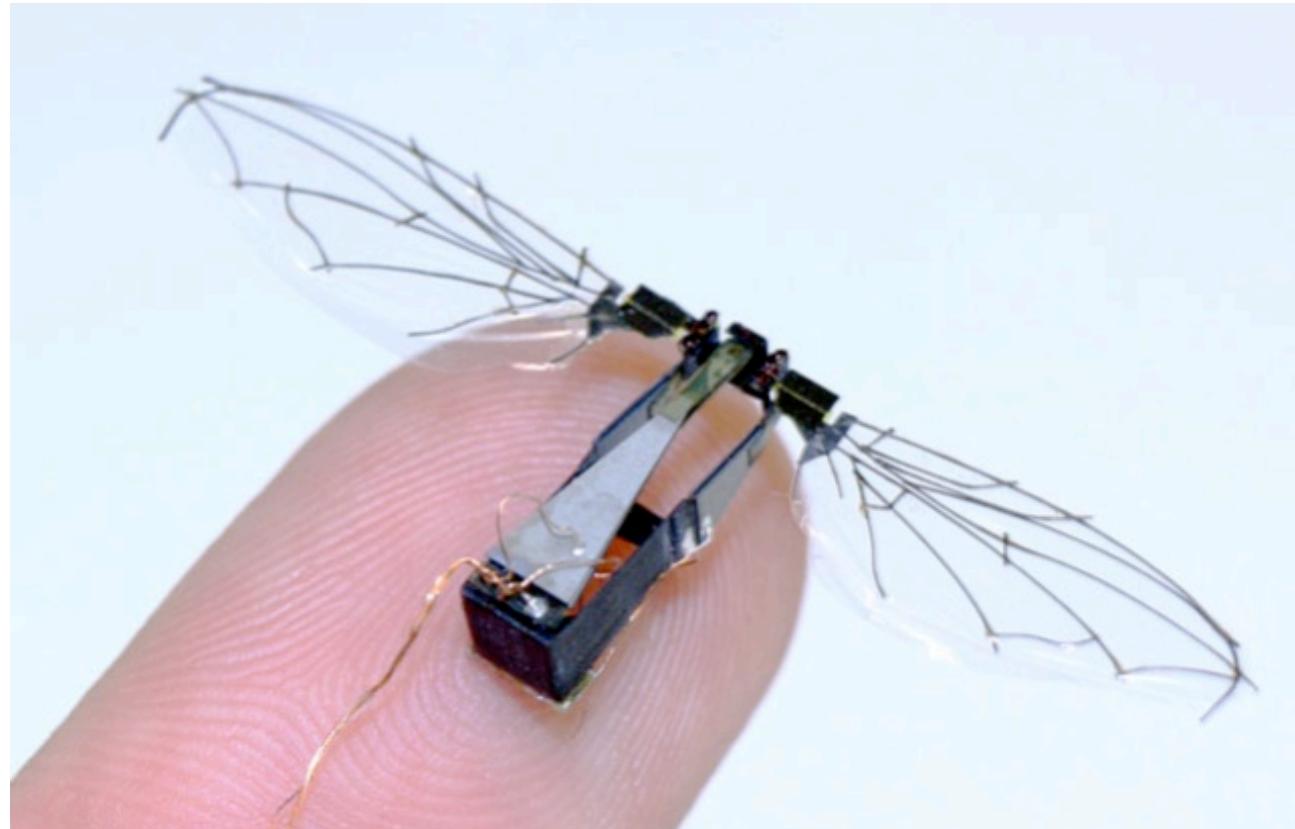


Bio-inspired microrobotics



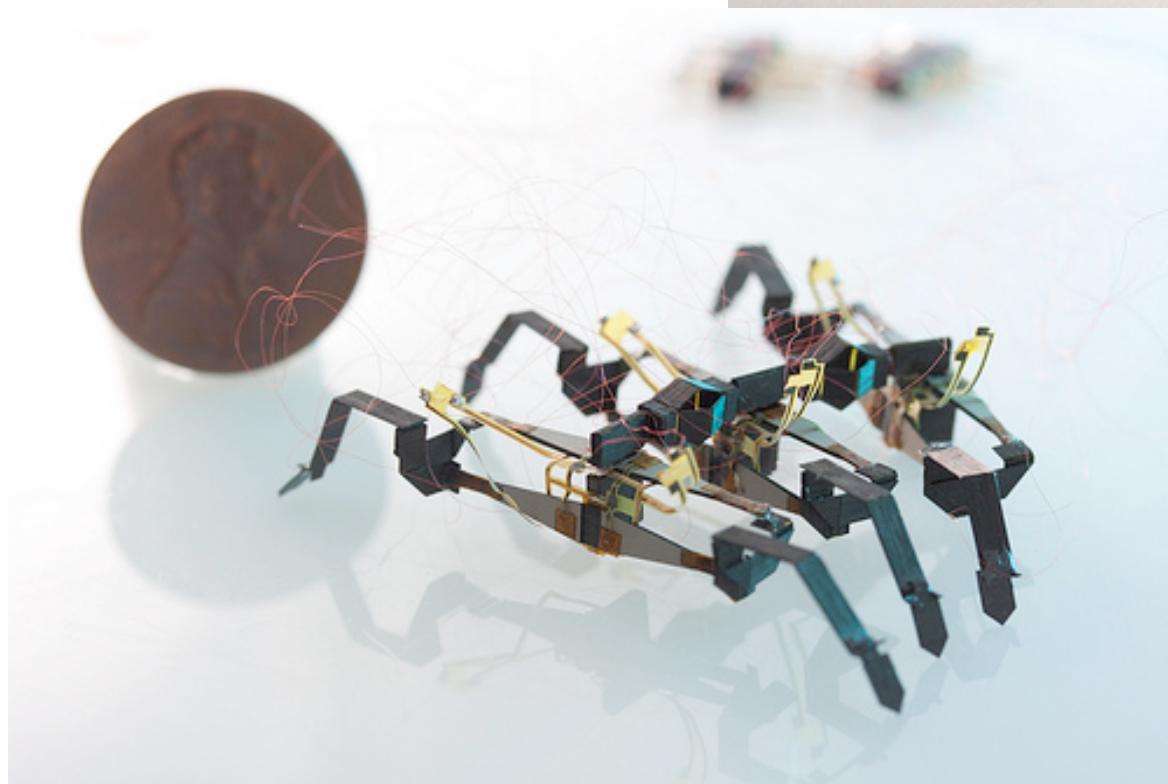
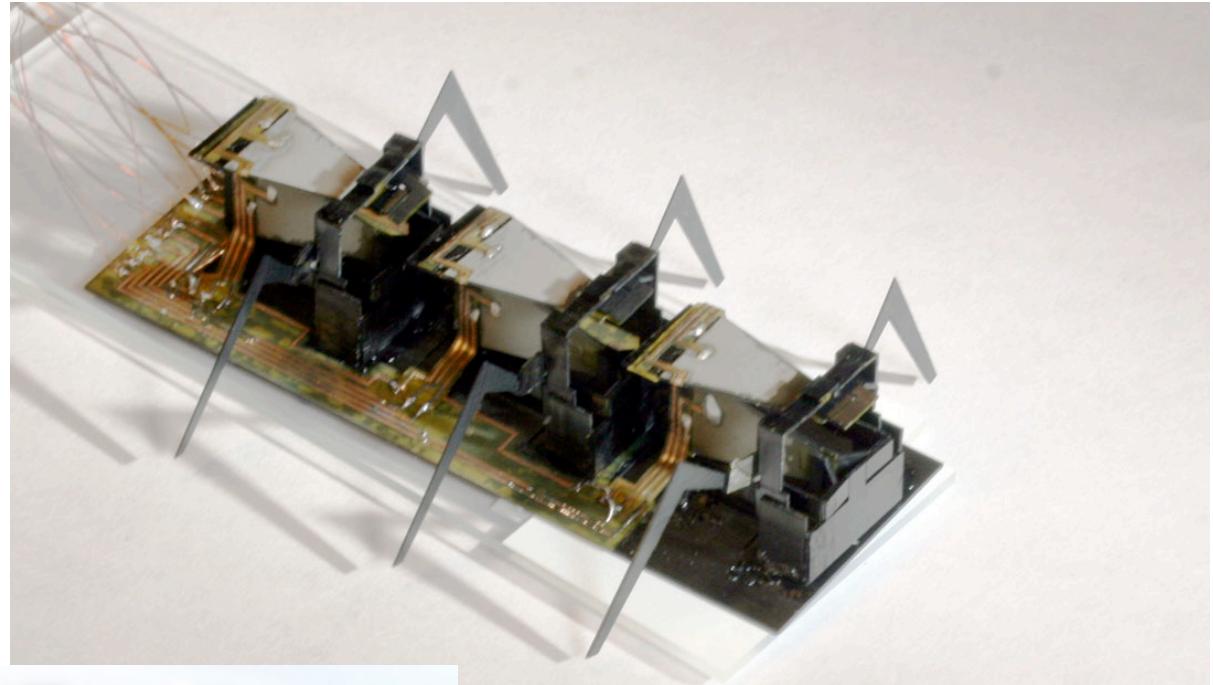
Bio-inspired microrobotics

(not
microbiotics!)



Flying

Crawling





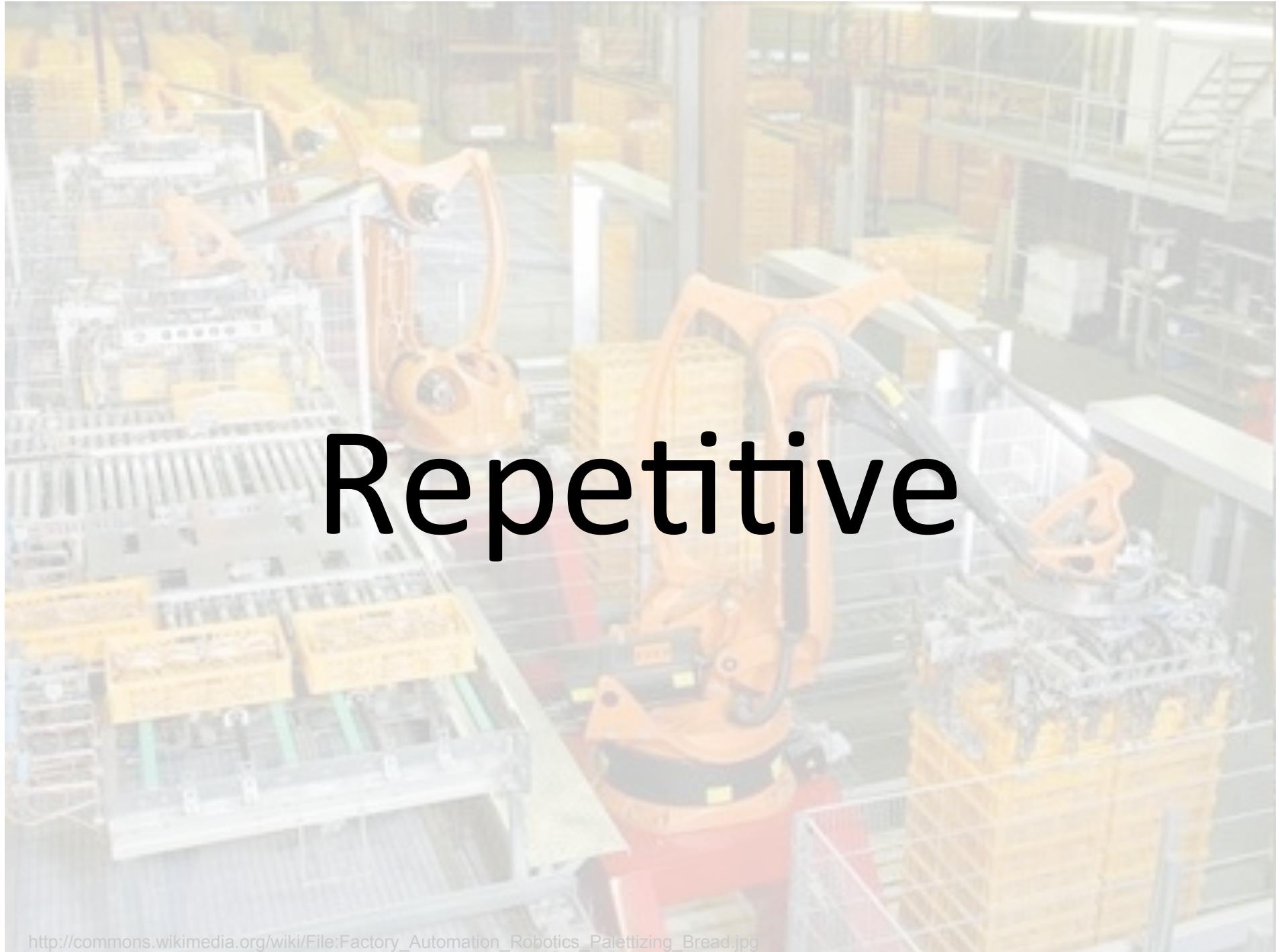
Squishy



Why?







Repetitive



Image credit: Larry D. Moore, http://commons.wikimedia.org/wiki/File:Roomba_original.jpg



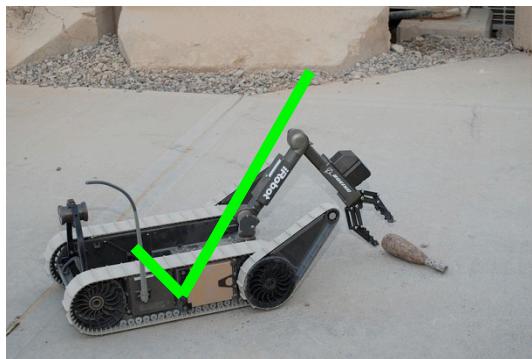
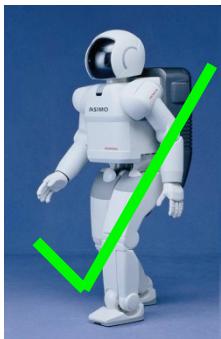
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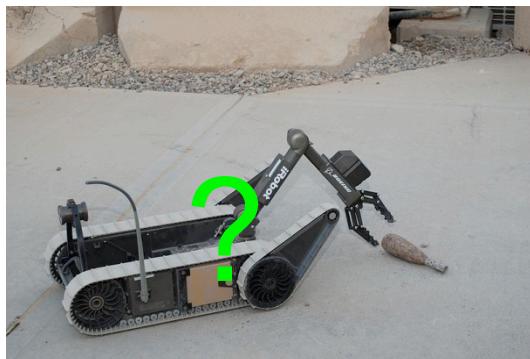
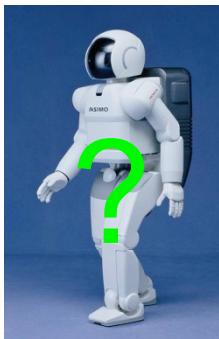
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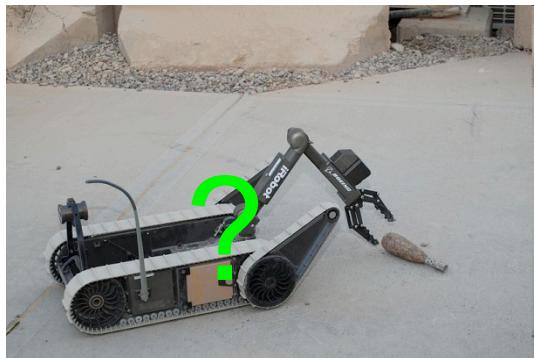


Dangerous!



http://commons.wikimedia.org/wiki/File:Amtsgericht_Berlin_Staircase_from_top_01.jpg





http://commons.wikimedia.org/wiki/File:Teuchl_stream.jpg



http://commons.wikimedia.org/wiki/File:Seattle_-_619_Western_-_crack_in_wall.jpg

But why would you
want to go through a
crack in the wall...?





http://commons.wikimedia.org/wiki/File:Haitian_women_amidst_rubble_in_Port-au-Prince_2010-01-20.JPG



http://commons.wikimedia.org/wiki/File:US_Navy_100114-N-6266K-090_Members_of_Fairfax_County_Urban_Search_and_Rescue_conduct_a_rescue_operation_in_a_collapsed_section_of_the_Hotel_Montana_in_Port-au-Prince,_Haiti_during_a_search_for_survivors_of_a_7.0_magnitude_earthquake.jpg

http://commons.wikimedia.org/wiki/File:US_Navy_100114-N-6206K-090_Members_of_Fairfax_County_Urban_Search_and_Rescue_conduct_a_rescue_operation_in_a_collapsed_section_of_the_Hotel_Montana_in_P%C3%B4rt-au-Prince,_Haiti_during_a_search_for_survivors_o



What *can* do all of
that?



http://commons.wikimedia.org/wiki/File:Housefly_on_a_leaf_crop.jpg

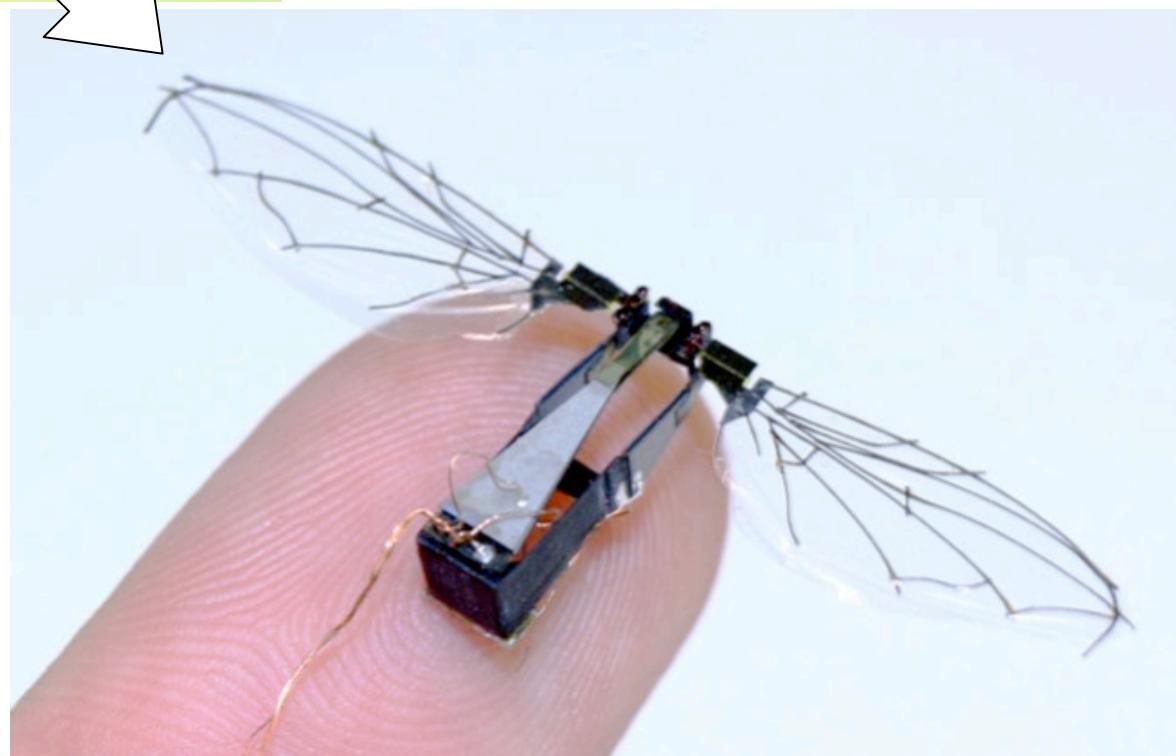
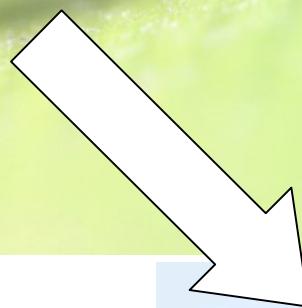


<http://commons.wikimedia.org/wiki/File:BeeCropped.jpg>

http://commons.wikimedia.org/wiki/File:Housefly_on_a_leaf_crop.jpg

http://commons.wikimedia.org/wiki/File:House_centipede.jpg

<http://species.wikimedia.org/wiki/File:Cockroachcloseup.jpg>



How...

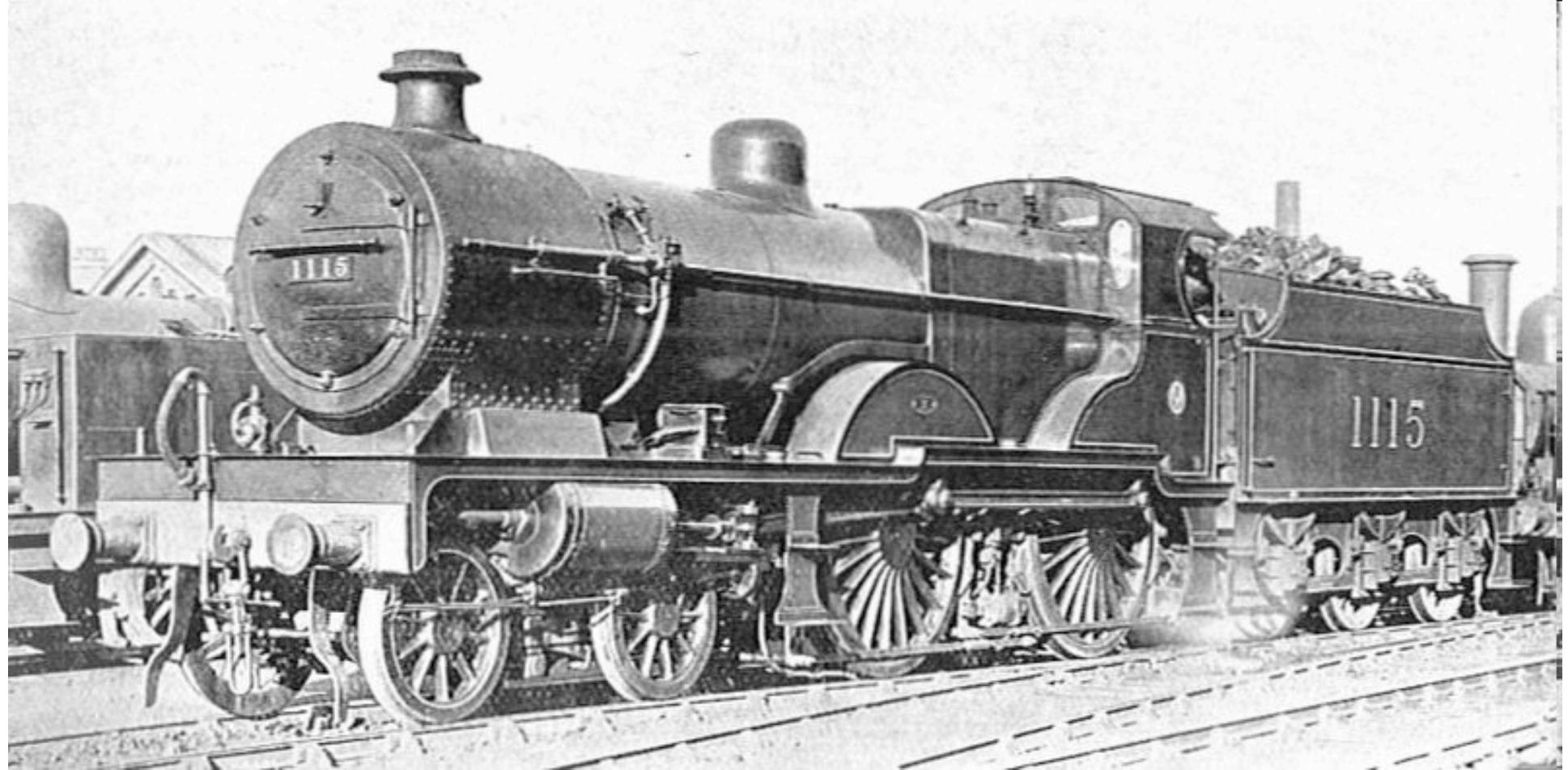
...do we build them?

**...do we make them fly,
crawl or squirm?**

Machines



http://commons.wikimedia.org/wiki/File:Midland_compound,_1115_%28CJ_Allen,_Steel_Highway,_1928%29.jpg



http://commons.wikimedia.org/wiki/File:Midland_compound,_1115_%28CJ_Allen,_Steel_Highway,_1928%29.jpg



<http://upload.wikimedia.org/wikipedia/commons/3/36/Jal.747.newcolours.arp.750pix.jpg>



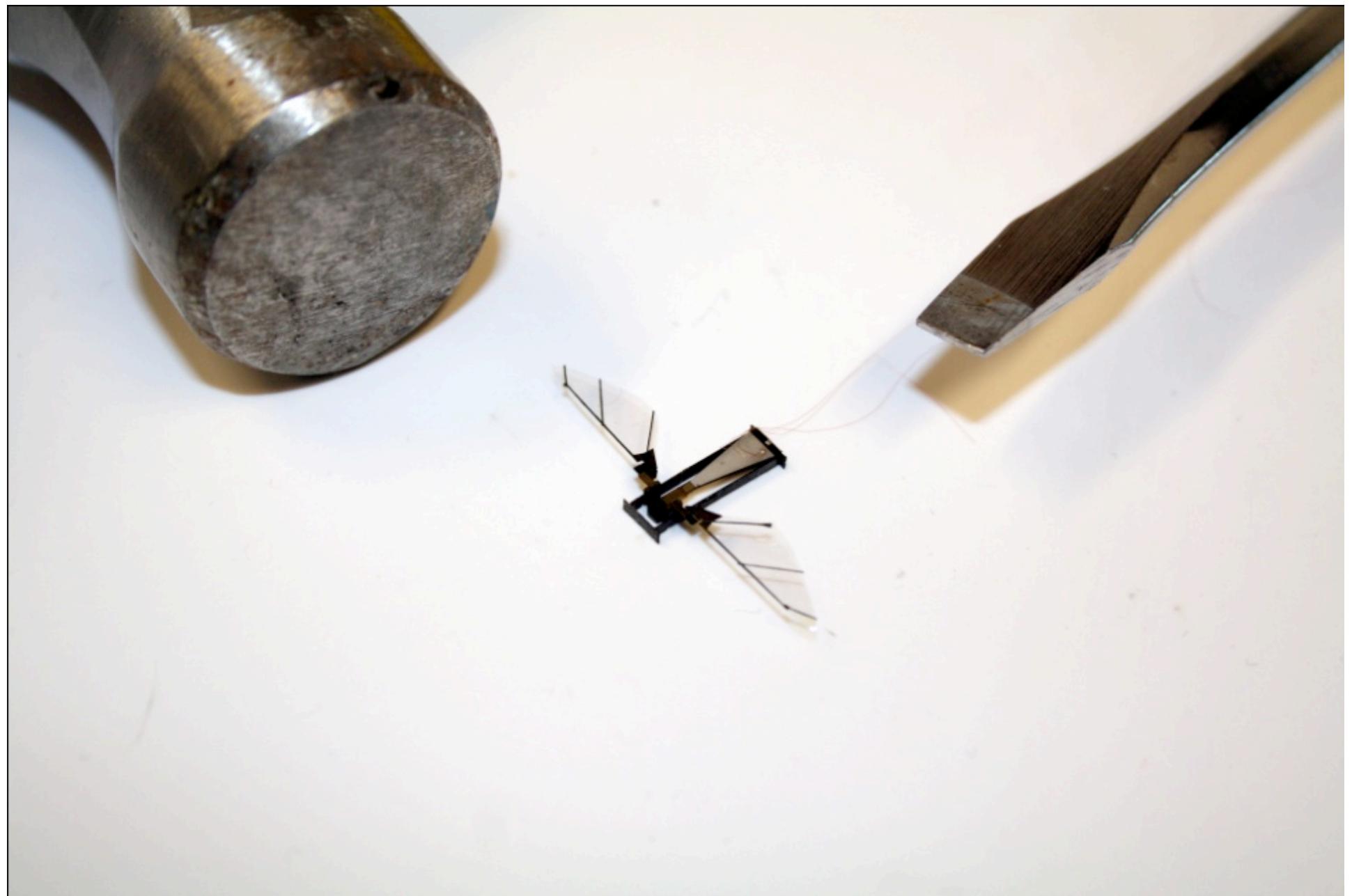


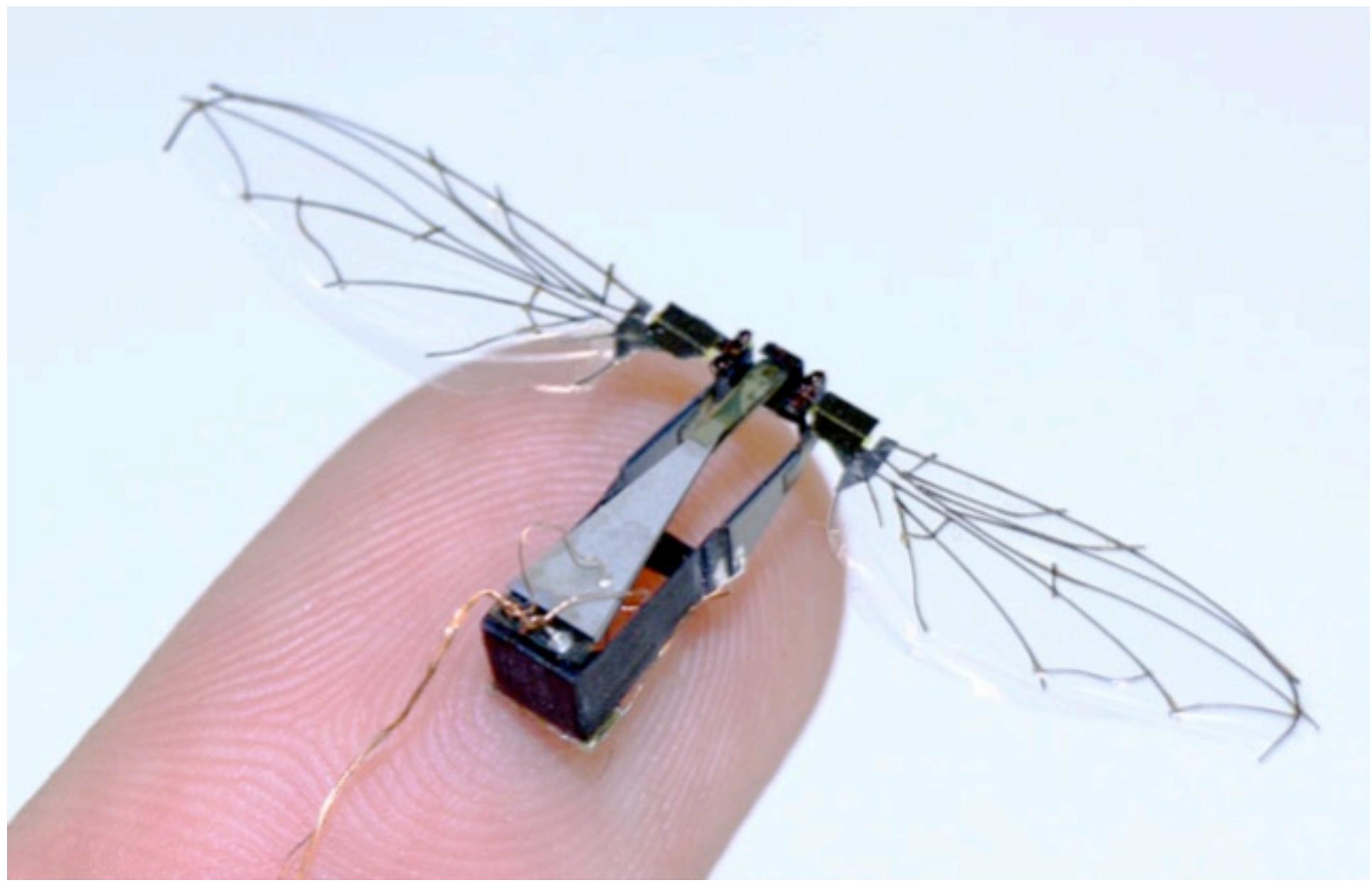
http://commons.wikimedia.org/wiki/File:Atlantis_taking_off_on_STS-27.jpg

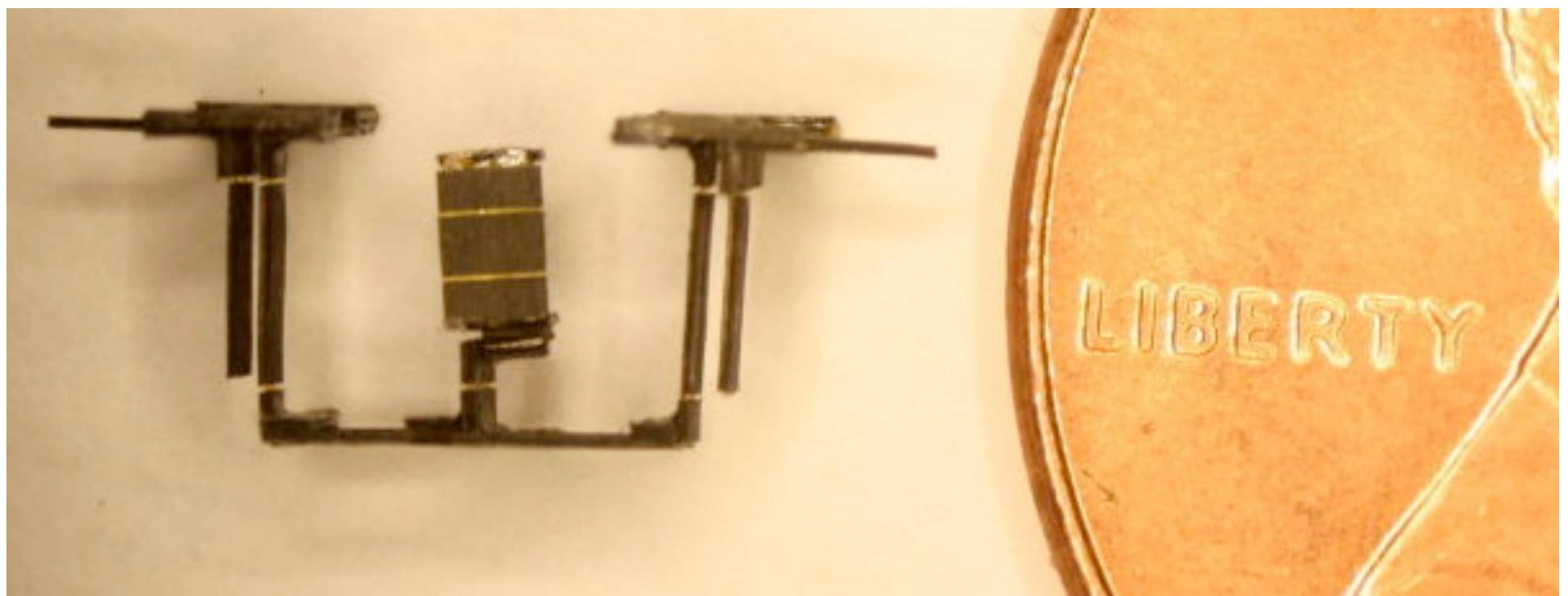
Problem...













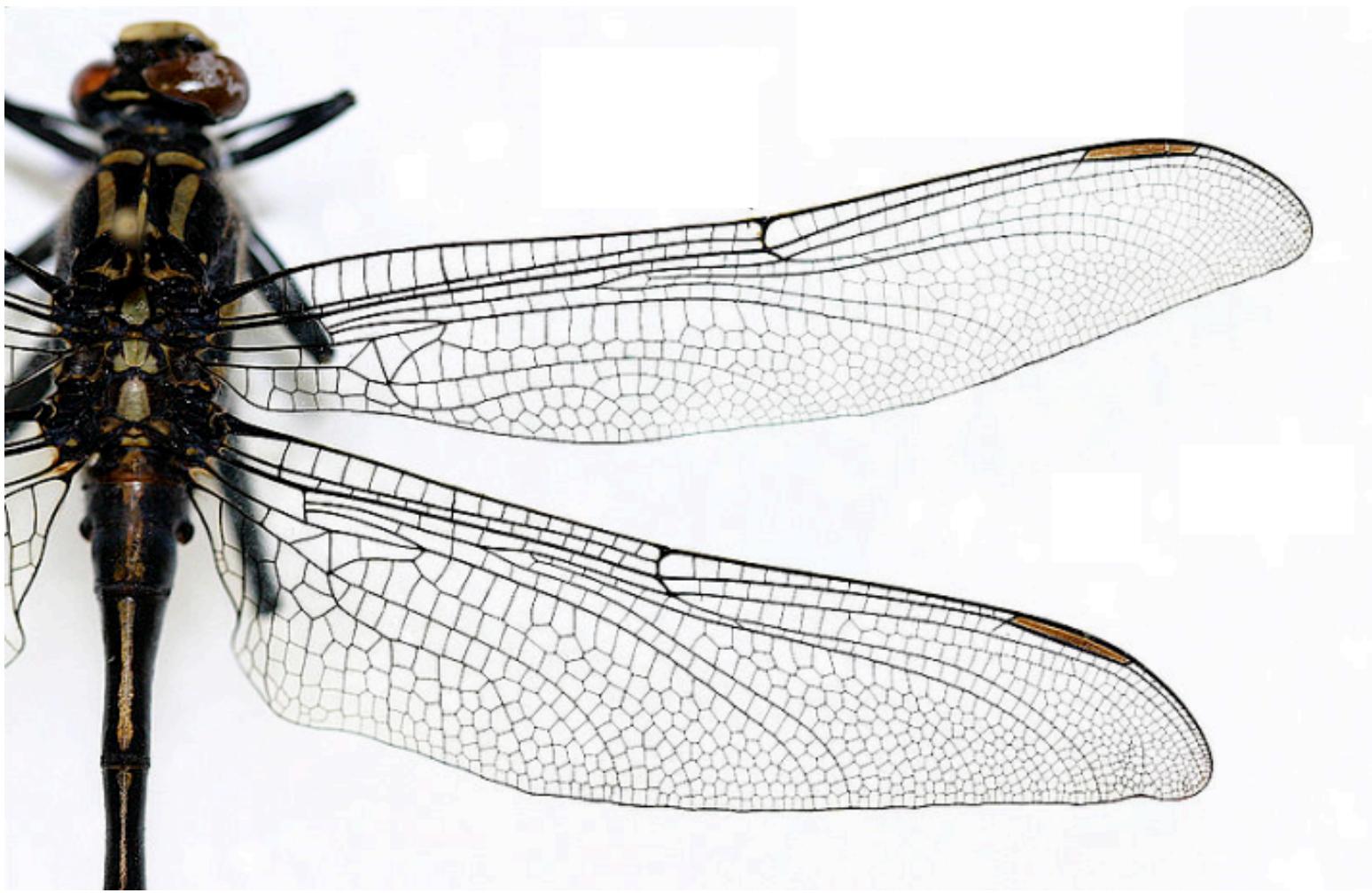
Flying



http://commons.wikimedia.org/wiki/File:FA18_on_afterburner.jpg

http://commons.wikimedia.org/wiki/File:Propeller_EP-3E_1500x2100.jpg

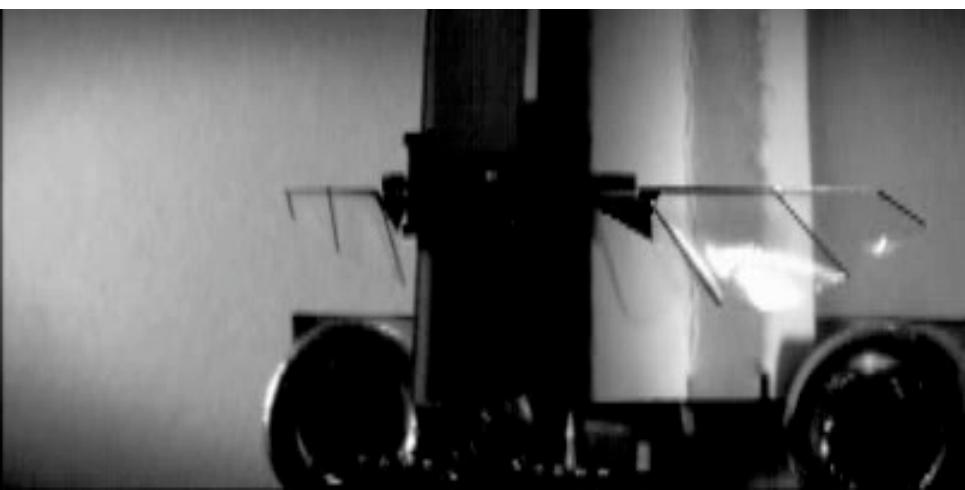
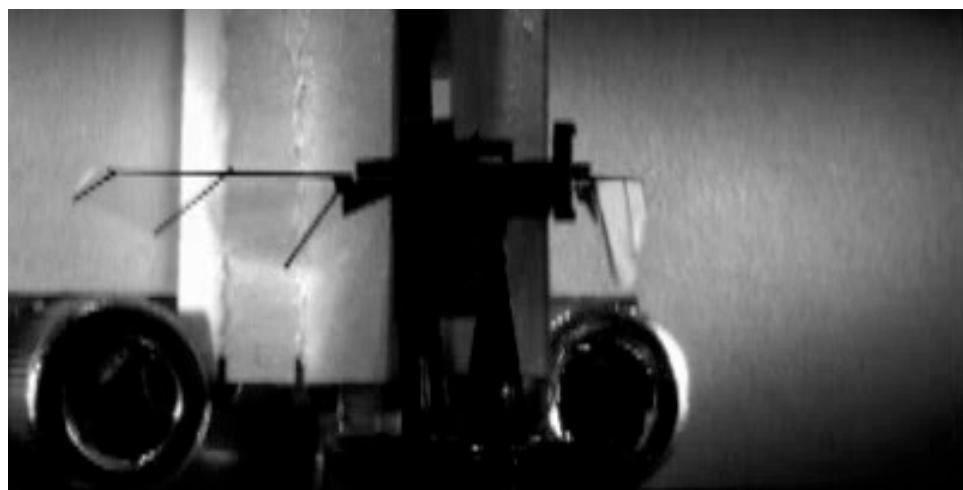


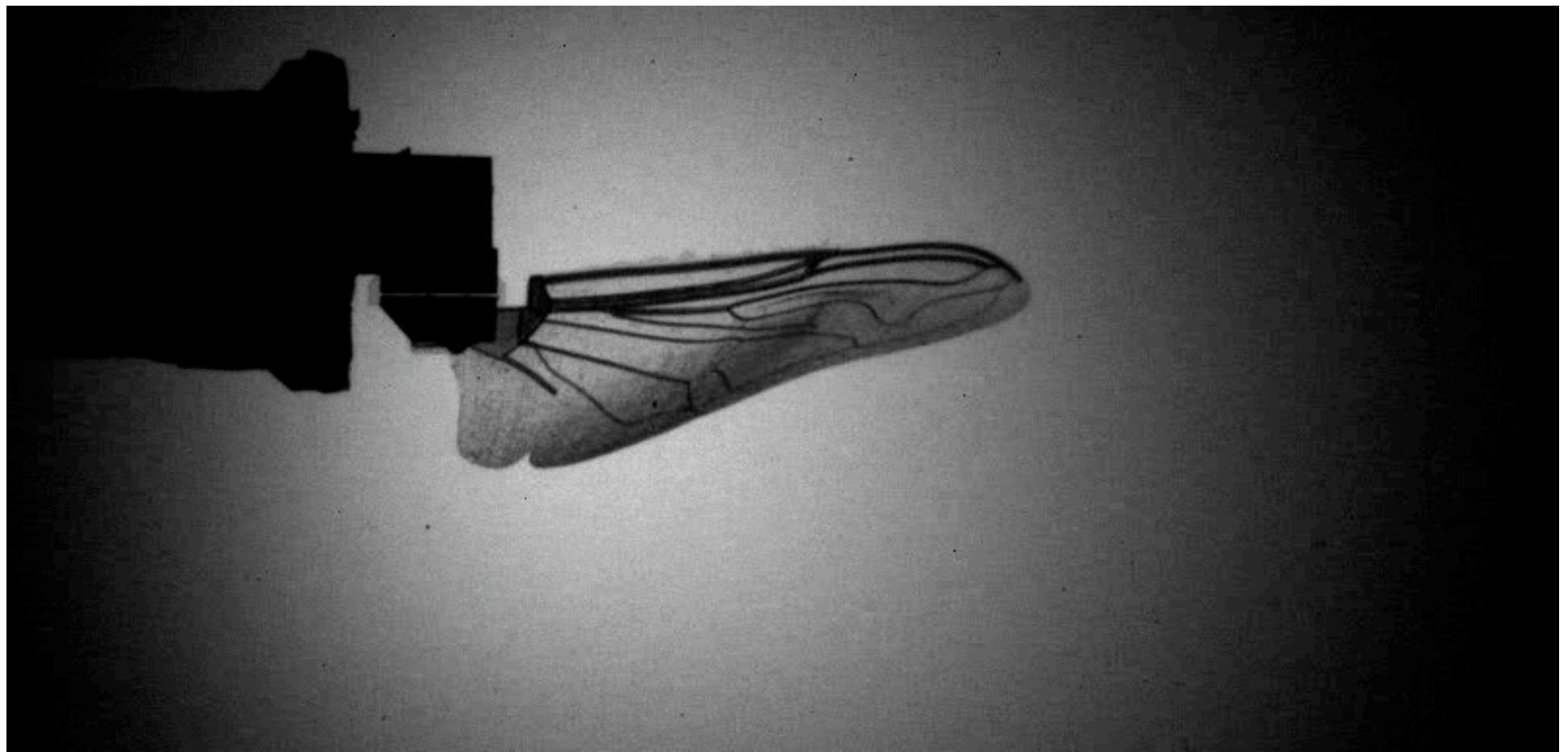




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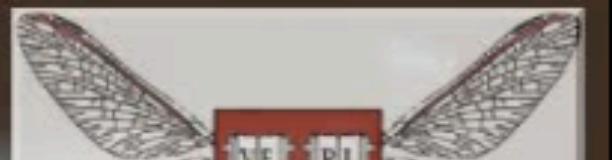
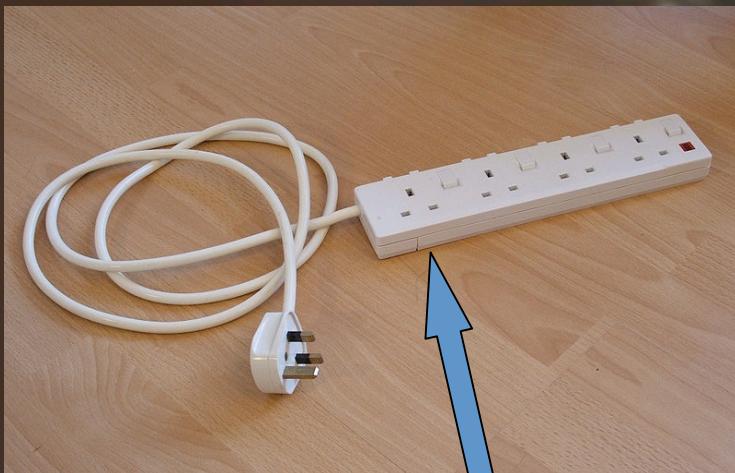






The Harvard Microrobotics Lab

First flight of a 60mg,
3cm flapping-wing MAV

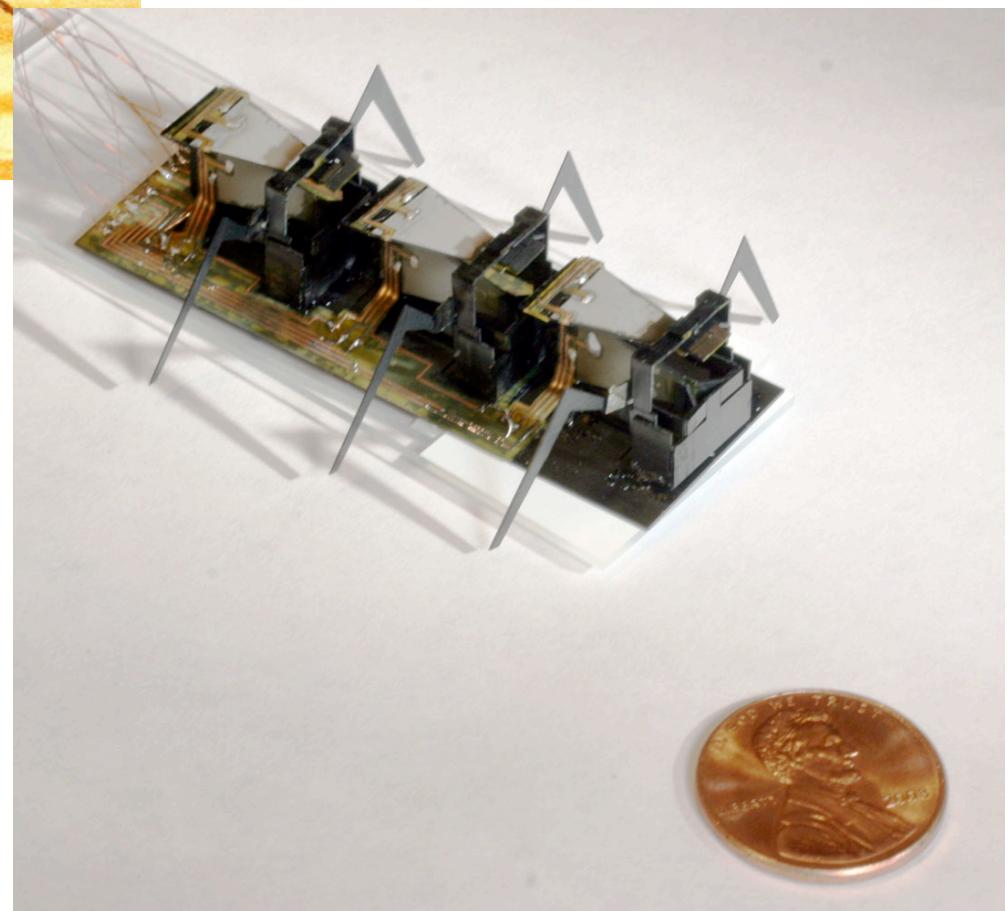


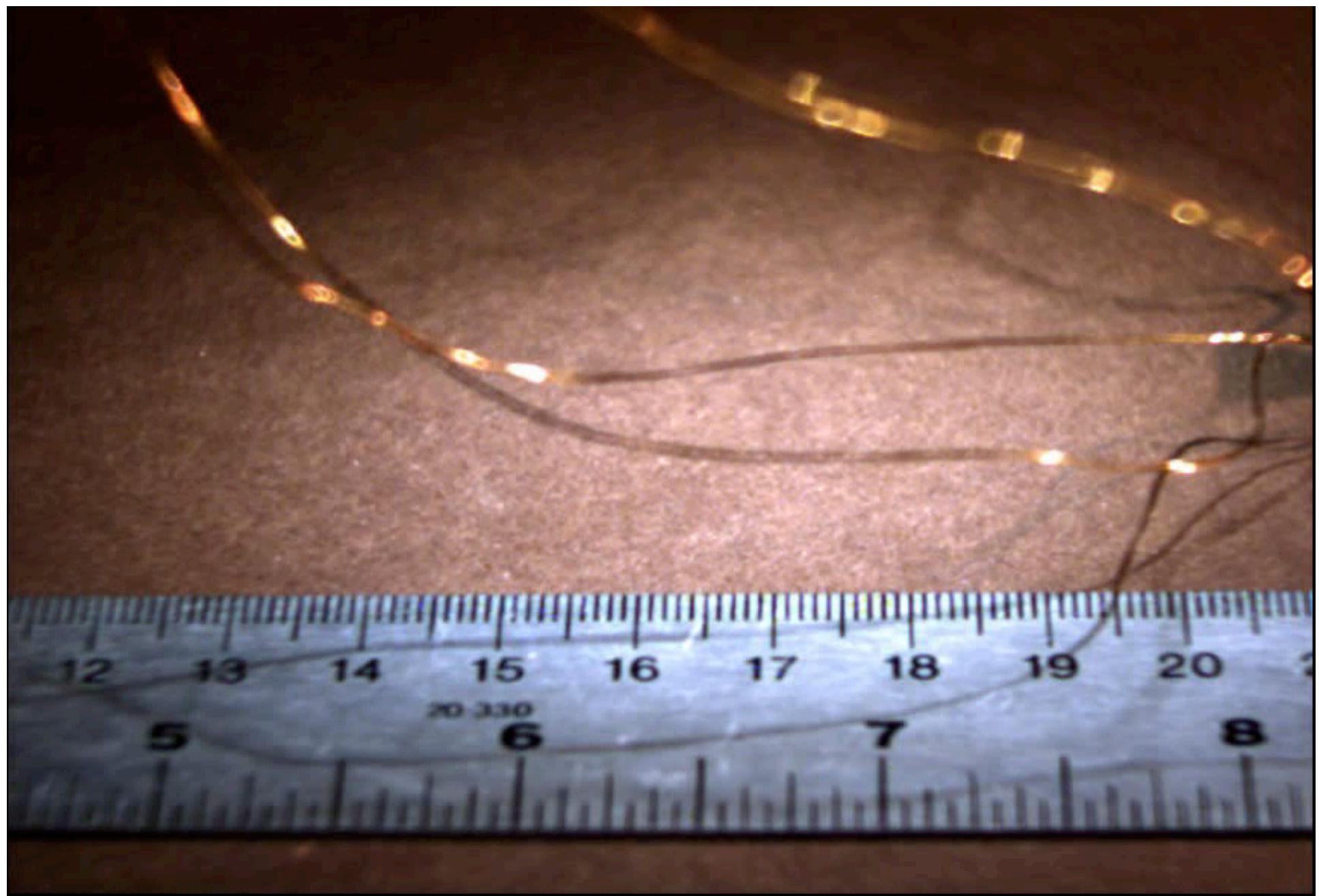
<http://commons.wikimedia.org/wiki/File:Extensioncord.jpg>

http://commons.wikimedia.org/wiki/File:Boy_with_helmet_on_training_wheels.jpg

Crawling

Spagna 2007, "Distributed mechanical feedback in arthropods and robots simplifies control of rapid running on challenging terrain"







YouTube – “Garden Centipede”

