



Coordinating Robotic Bee Swarms

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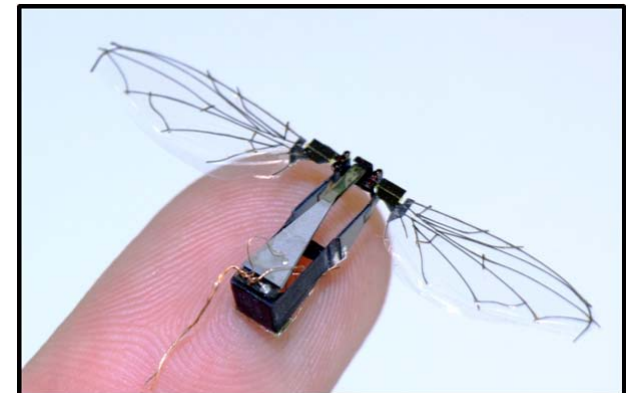
Why Robotic Bees?!

- About 30% of U.S. food supply pollinated by bees
- Colony Collapse Disorder (CCD) resulting in rapid demise of bee colonies

Year	Percentage bee population dead (in US)
2007	32%
2008	36%
2009	29%

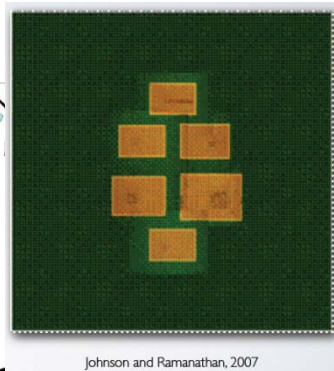
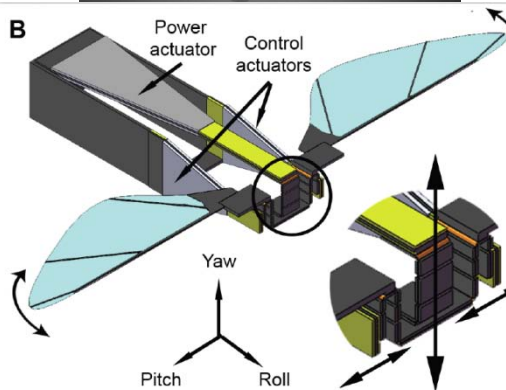
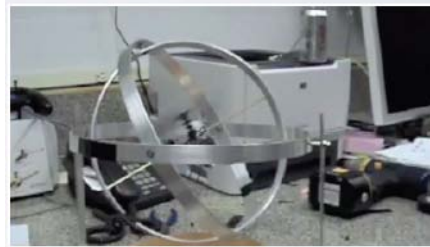
Solution: RoboBees

NSF Expeditions in Computing,
award #: CCF-0926148

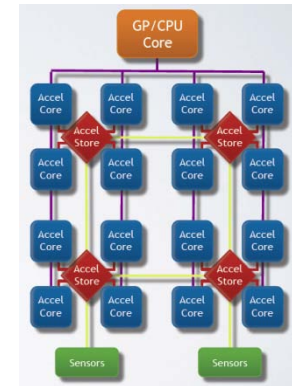


RoboBees: Convergence of Brain, Body and Colony

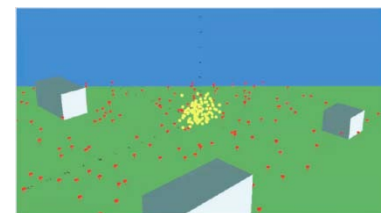
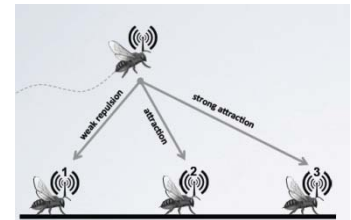
Body



Brain



Colony





Problems At Scale

- *Programming*
 - Single program for the swarm (macro-programming)
 - Compose individual robot behaviors easily
- *Resource coordination*
 - Dynamic topologies
 - Partial view of state
 - Applications spatial in nature: Exploration/Exploitation
- *Robustness*
 - Imprecise sensors
 - Imprecise proprioception
 - Changing environmental conditions



Challenges

- Actuation order of magnitude more energy-expensive
- Connectivity is very intermittent due to mobility
- Optimize communication to facilitate better decision making
- Application specific dissemination mechanism to provide an illusion of complete information

STATE	POWER (mW)
Proc standby	11.2
Proc active	78.4
Radio rcv	50.82
Radio tx	56.1
Hover	1850
Full throttle	2775



Vision

