Insect spy drone

Autor:
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The Micromechanical Flying Insect (MFI) is a miniature UAV (unmanned aerial vehicle) composed of a metal body, two wings, and a control system. Launched in 1998, it is currently being researched at University of California, Berkeley.[1] The MFI is among a group of UAVs that vary in size and function. The MFI is proving to be a practical approach for specific situations. The US Office of Naval Research and Defense Advanced Research Project Agency are funding the project. The Pentagon hopes to use the robots as covert "flies on the wall" in military operations.[2][3] Other prospective uses include space exploration and search and rescue.[4]

Contents

Comparison with other UAVs
There are a variety of UAVs that perform different operations. The MFI is of greatest potential use to the United States Military. There are currently various UAVs in this field that perform tasks such as gaining battlefield intelligence or being a decoy for potential missiles. In respect to gaining battlefield intelligence there are many drones in use by the military to execute different missions.[5] The US Military is constantly upgrading to stealthier UAVs that can perform more missions while remaining virtually undetected. Essential qualifications for a military grade UAV include:

Size
Noise level
Versatility

This is what makes the MFI a great candidate for the military. It takes the functions of larger UAVs and crunches it down into a miniature undetectable device. It virtually eliminates size and noise level and increases versatility beyond the capabilities of current UAVs. The actual "crunching" of these capabilities into the MFI raises the problem of creating a supple frame and a pair of wings with an autonomous computer to control them.

Technical aspects
Structure and materials
The initial prototypes of the MFI weighed 100 milligrams and had wingspans of 2 centimeters. They were structured with

stainless steel beams and polymer flexures as joints. This created a weight-to-lift ratio that led to an issue with achieving flight. The beams and joints were then changed to lighter materials that perform better. The beams were converted from stainless steel to honey-comb carbon fiber beams, while the joints were changed to silicon, mimicking typical micromechanical structures. These raw materials used cost around 10 cents to construct.[6]

Functions and mobility

The overall functionality of the MFI is broken up into smaller components that cohesively work with one another to sustain a stable and particular flight pattern. These components are:

Power supply - a battery pack rechargeable through solar panels on the exterior body
Sensory system - a group consisting of two eyes and multiple temperature, wind, and speed sensors
Locomotive and control - the wings connected to respective actuators
Communication - the internal network of algorithms and sensory signals

These units work together to take a specific task, such as "fly forward", as an input and signals are sent through to both wings to produce a calibrated output to perform the task. This is a more in depth view of the flow of operations; the initial visual system analyzes the location in three-dimensional space, through computing the displacement between objects and itself. The fly is then chosen to execute a task, i.e. "find an object" or "explore". Unlike other UAVs, the MFI has to have an autonomous computer system because it is too small to be controlled by a remote, so it must be able to sustain itself. Once the action has been chosen the signal moves on to the inertial system to then distribute the specific functions, in respect to the action, to the wings. The wings then use a number of sensors to deliver the most accurate wing thrusts to fulfill the action.[7]

Problems and complications

There are problems pertaining to this system that have arisen during the development of the MFI, and this has demanded further research. The first problem is the initial input of visual data that is to be computed. There is a substantial degree of noise in the data obtained through the "eyes", when this is passed through the system to the wings it produces an inaccurate output therefore not achieving the initial action correctly.[7]

Another problem is the "hovering" method of the MFI. Essentially the MFI has to be in equilibrium in three-dimensional space while producing a wing thrust that will sustain the desired altitude. The issue with this concept is the inadequate research on the flight patterns of flies, furthermore creating an algorithm to perform such patterns.[7]

Timeline of development

1998 – Research began at University of California, Berkeley through a $2.5 million contract.
2001 – The prototype (with a single wing) showed thrust forces on a test stand.
2002 – Fabrication was switched from folded stainless steel to carbon fiber.
2003 – 500 microNewtons of lift from a single wing was demonstrated on a test stand.
2003 to current – Work concentrated on reducing weight, increasing actuator power density, increasing air frame strength, and improving wing control.[1]

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External links

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Is this a mosquito?

No. It’s an insect spy drone for urban areas, already in production, funded by the US Government. It can be remotely controlled and is equipped with a camera and a microphone. It can land on you, and it may have the potential to take a DNA sample or leave RFID tracking nanotechnology on your skin. It can fly through an open window, or it can attach to your clothing until you take it in your home.

One of the current areas of research reportedly being undertaken in the scientific/military field is the development of micro air vehicles (MAVs), tiny flying objects intended to go places that cannot be (safely) reached by humans or other types of equipment. One of the primary military applications envisioned for MAVs is the gathering of intelligence (through the surreptitious use of cameras, microphones, or other types of sensors); among the more extreme applications posited for such devices is that they may eventually be used as “swarm weapons” which could be launched en masse against enemy forces.

Some efforts in MAV research have involved trying to mimic birds or flying insects to achieve flight capabilities not attainable through other means of aerial propulsion. In 2007 a bug-like MAV model with a 3-cm wingspan was displayed at a robotics conference, in 2008 the U.S. Air Force released a simulated video showing MAVs about the size of bumblebees, and in 2012 engineers at Johns Hopkins University were studying the flight of butterflies to “help small airborne robots mimic these maneuvers.”

The specific mosquito-like object pictured above is, however, just a conceptual mock-up of a design for a MAV, not a photograph of an actual working device “already in production.” And although taking DNA samples or inserting micro-RFID tracking devices under the skin of people are MAV applications that may some day be possible, such possibilities currently appear to be speculative fiction rather than reality.

Some have claimed the U.S. government has not only researched and developed insect-like MAVs, but for several years has been furtively employing them for domestic surveillance purposes:

The US government has been accused of secretly developing robotic insect spies amid reports of bizarre flying objects hovering in the air above anti-war protests.

No government agency has admitted to developing insect-size spy drones but various official and private organisations have admitted that they are trying.

But official protestations of innocence have failed to kill speculation of government involvement after a handful of sightings of the objects at political events in New York and Washington.

Vanessa Alarcon, a university student who was working at an anti-war rally in the American capital [in September 2007], told the Washington Post: “I heard someone say, ‘Oh my God, look at those.’

“I look up and I’m like, ‘What the hell is that?’. They looked like dragonflies or little helicopters. But I mean, those are not insects.”

Bernard Crane, a lawyer who was at the same event, said he had “never seen anything like it in my life”. He added: “They were large for dragonflies. I thought, ‘Is that mechanical or is that alive?’”

The incident has similarities with an alleged sighting at the 2004 Republican National Convention in New York when one peace march participant described on the internet seeing “a jet-black dragonfly hovering about 10 feet off the ground, precisely in the middle of 7th Avenue”.

Entomologists suggest that the objects are indeed dragonflies. Jerry Louton, an expert at the National Museum of Natural History, said Washington was home to large, impressively-decorated dragonflies that “can knock your socks off”.

Others maintain the technical obstacles involved in creating flying insect-sized robots have yet to be overcome:

The technical challenges of creating robotic insects are daunting, and most experts doubt that fully working models exist yet. “If you find something, let me know,” said Gary Anderson of the Defense Department’s Rapid Reaction Technology Office.

Getting from bird size to insect size is not a simple matter of making everything smaller.

“You can’t make a conventional robot of metal and ball bearings and just shrink the design down,” said Ronald Fearing, a roboticist at the University of California at Berkeley. For one thing, the rules of aerodynamics change at very tiny scales and require wings that flap in precise ways — a huge engineering challenge. Scientists have only recently come to understand how insects fly.

Even if the technical hurdles are overcome, insect-size fliers will always be risky investments. “They can get eaten by a bird, they can get caught in a spider web,” Professor Fearing said.

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By

David Mikkelson