CYBORG INSECT: Living Insect Based Flapping and Legged Machine

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What is CYBORG INSECT?

It is the fusion of living insect and man-made machine & computer. A radio-built-in miniaturized computer (micro controller) is mounted on a living insect and the computer outputs electrical signal (stimulus) to neuromuscular system (brain, ganglion, neurons, muscles) of the insect in order to induce one's desired motor actions and behaviors.

Application

Potential applications of the cyborg insect include rescue mission, homeland security and criminal investigation.
As a tiny flapping flyer and legged machine, the cyborg insect can navigate into areas which are not accessible for human.

Method

Which insect?

Among many insect orders, we chose beetle (Coleopteran) as beetle is a powerful flyer. Beetle can carry 30 % of its own body mass in flight. A giant flower beetle, Mecynorhina torquata beetle, has been employed as the insect platform for cyborg insect, which has 10 g for its own mass. We found Mecynorhina beetle actually has 3 g payload capacity in flight.

How to stimulate?

We mounted a radio built-in microcontroller (Texas Instruments) and two jumper female connectors (lead to the I/O pins of the microcontroller) onto a custom designed PCB (printed circuit board). The assembly of PCB (the total mass is ca. 1.3 g) was glued on the backside of the beetle. Thin silver wires (AM systems) are inserted into the female connectors and the other ends of the wires were implanted into the optic lobes (massive neural cluster of compound eyes) and flight muscles (basalar and wing folding muscles). The microcontroller was wirelessly commanded by user to output defined waveform of electrical stimulus pulse trains at defined frequencies on demand.

Results

Initiating flight (take-off) was achieved by applying multi-pulse trains to the optic lobes, whereas flight cessation (landing) was achieved by applying a single long-duration pulse. Applying multi-pulse trains to the brain induced insect descent. A left turn was induced by multi-pulse trains to the right basalar muscle, and vice versa. At the presentation onsite, we will show movies of demonstrations of those flight controls.