Locomotor-related spike activity of protocerebral neurons in freely walking crickets

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We have developed an experimental system for simultaneous recording of the locomotor behavior and neural activities from freely walking insects. The system consists of a motion-tracking subsystem, an active slip ring, and conventional extracellular recording devices. The system measures two behavioral parameters, i.e., the 2-D coordinates of the animal's position within an area 420-mm square and the orientation of the body axis at 30 Hz; in addition, 2 CH extracellular neural activities are recorded using bipolar wire electrodes (OD, 20 μm × 2). We applied this system to the field cricket (*Gryllus bimaculatus*) and recorded spike unit activity from the brain during spontaneous walking. In some cases, by using wire electrodes whose tips were coated with a fluorescent dye (Lucifer yellow), the locations of neurons were specified after the experiment. Locomotor-related spike units were mainly located in the protocerebral area, particularly around the mushroom body and central complex. The neurons were classified into several types according to their locomotor-related discharge patterns. In addition, most of these neurons exhibited excitatory responses for mechanical stimuli to the antennae, legs, and body surface and also for the stimulus of wind to the cerci.