

# Rat Troilus

## A Wireless Epidural Electrical Stimulation System for Rats

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### Abstract

We have developed a wireless epidural electrical stimulation system to control rat movements by providing stimulus with adjustable parameters on different epidural motor cortex areas. A hand-made multi-channel electrode array is implanted above the endocranium of the rat. A mini-size, light-weighted and multi-channel stimulus controller is carried on the rat's back, controlling by PC wirelessly. Different specific actions can be evoked in vivo experiments.

### Background

The effect of stimulation on motor cortex is related to the stimulation frequency, intensity, pulse width, duty ratio, pulse waveform (unipolar or bipolar), electrode polarity (anode or cathode), distance between electrode and nerve tissue and so on. A simple yet robust implantable stimulating surface electrode which can be fabricated in all laboratories with wet-bench has been developed by Russel et al.

### Methods & Results

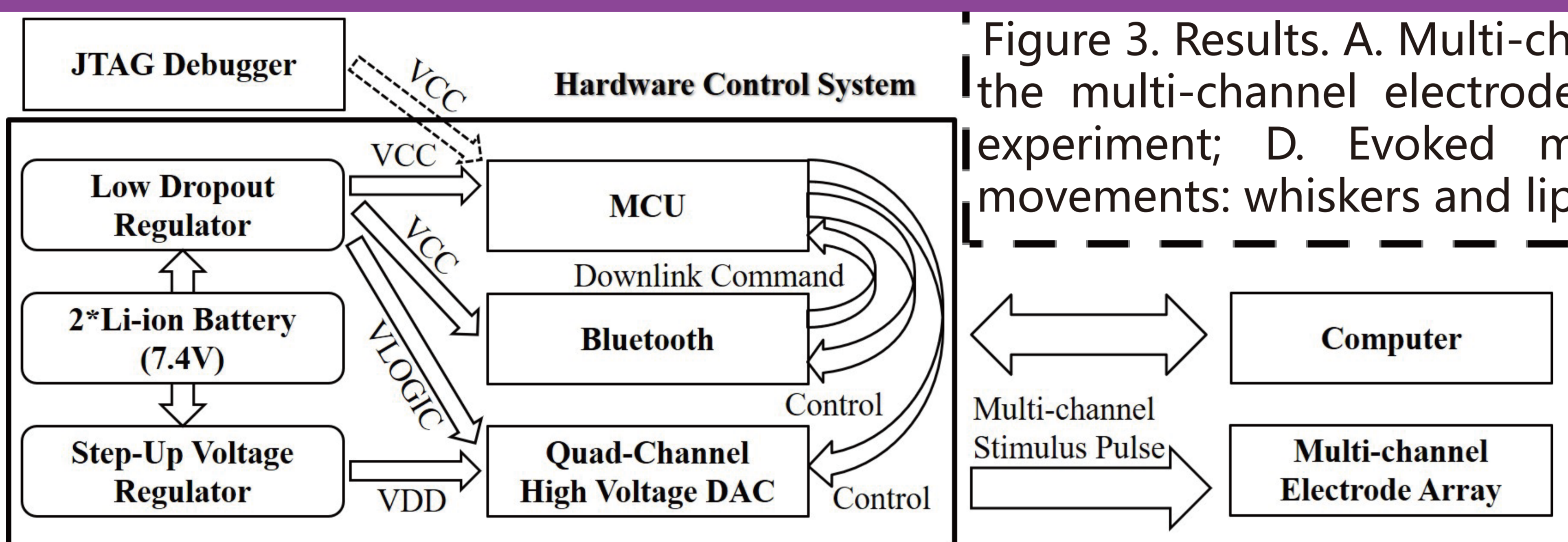


Figure 1. Schematic of the wireless epidural electrical stimulation system.

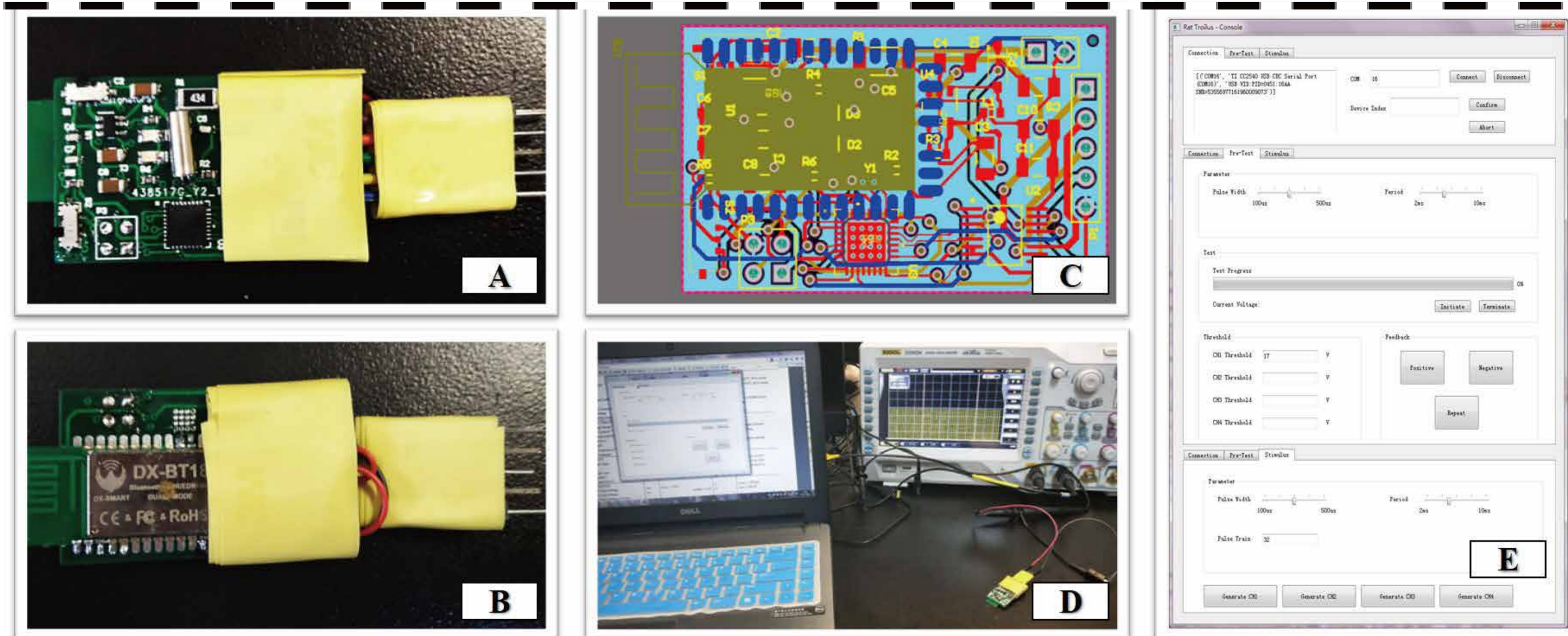
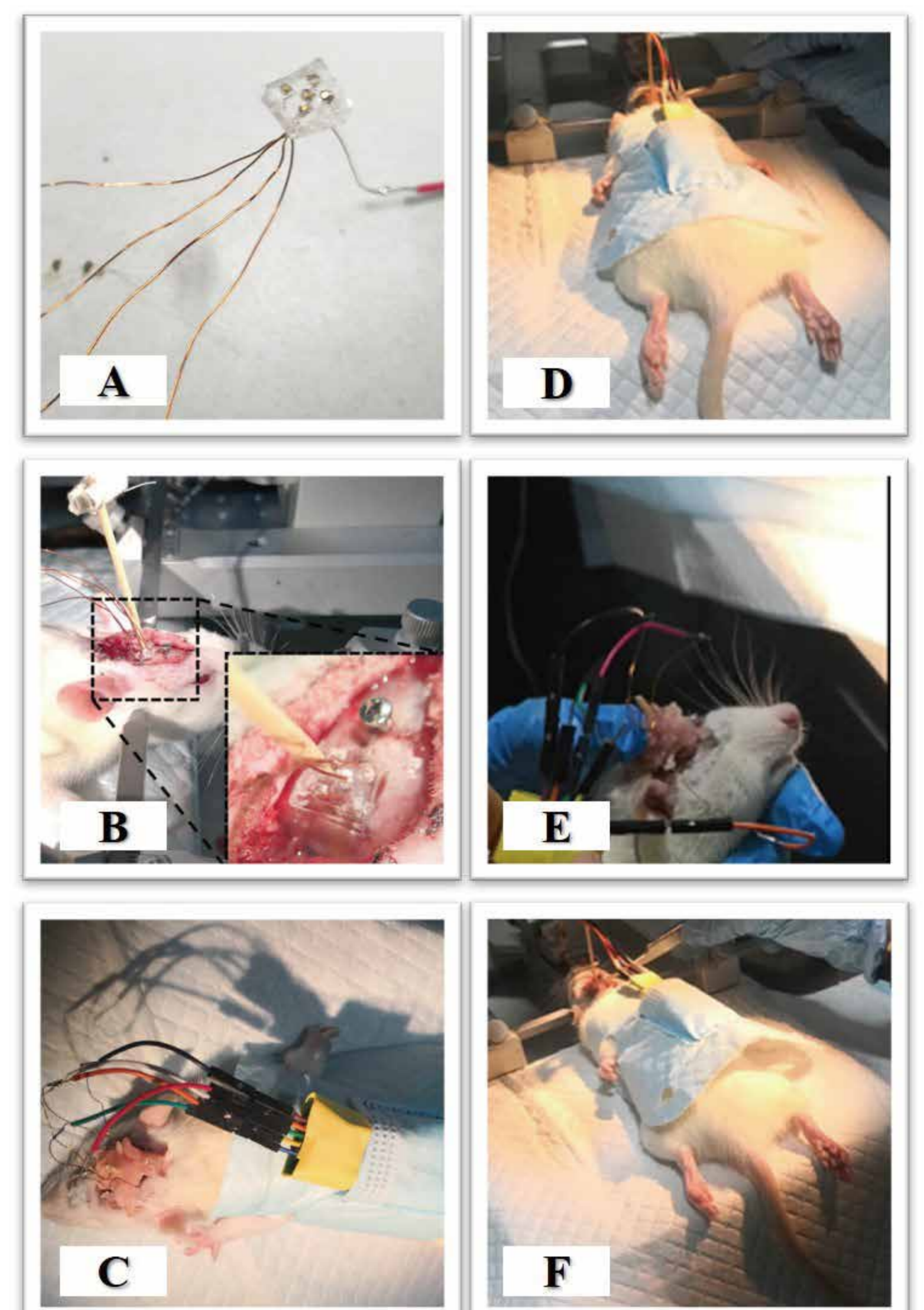


Figure 2. Components of the system. A.& B. Front view and back view of hardware control; C. PCB Design; D. Set-up of stimulus pulse generating test controlled by PC and monitored by oscilloscope; E. PC interface.

Figure 3. Results. A. Multi-channel Electrode Array; B. Implantation of the multi-channel electrode array; C. Experimental set-up of vivo experiment; D. Evoked movements: back muscles; E. Evoked movements: whiskers and lips; F. Evoked movements: hind limb.



### Conclusion

We have developed a wireless epidural electrical stimulation system for rats, which can generate multi-channel controllable stimulus ranging from 0 to 40 V and realize the stepping process by feedback. Movements of back muscles, whiskers and lips, and hind limbs of rat can be controlled by the system. The system is characterized by small size, adjustable pulse parameters, wireless control, multi-channel stimulation, high control accuracy, friendly PC interface with feedback control and excellent performance of the stimulation electrode array.

### Future Plan

System:  
Automatic closed-loop feedback based on EMG monitoring;  
More channels (such as 32) based on decoder and multi-channel high voltage DAC.

Electrode array:  
More stable, smaller and easier to make;  
More channels (such as 32) and higher precision;  
Less tissue damage and displacement for rats.