MENB-based Motor Function Rebuilding of Paralyzed Limbs of Hemiplegic Patients Caused by Stroke

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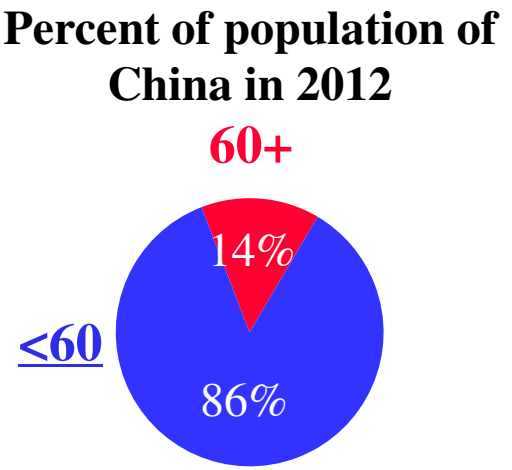
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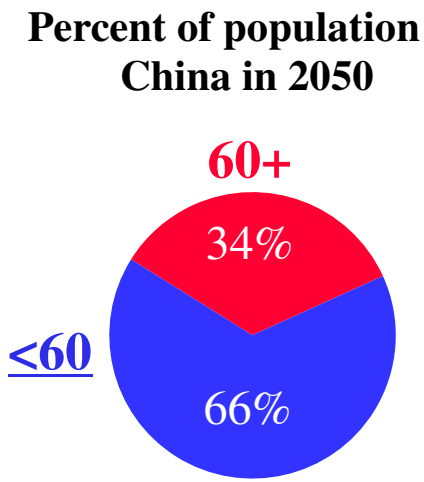
Highlights

- Background
- Concept of MENB
- System Design for Neural Function Rebuilding
- Animal and Clinical Experiments
- Conclusions

Background: Aging Problem of China

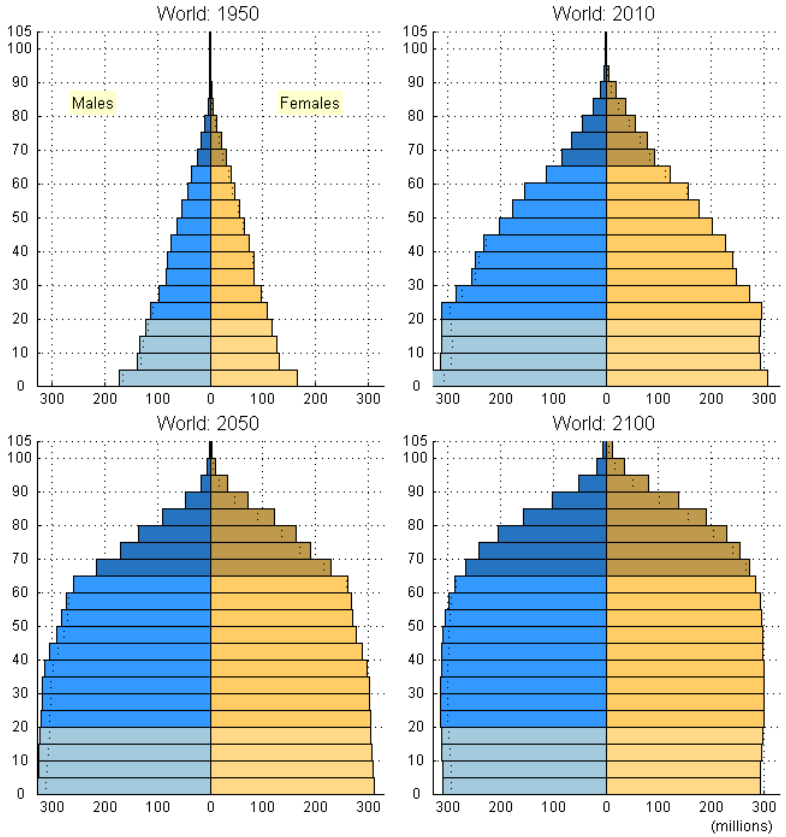
- On Feb. 24, 2013, the National Bureau of Statistics of China published that by the end of **2012** the population of **60+** older is **193.9 millions**, representing **14.3%** of China's population.
- It is estimated that in **2050** the population of 60+ older will increase to over **400 millions**, representing **34.3%** of China's population at that time.





Background: Aging Problem of the World

- The world's population is also growing older. The number of those over age 60 is projected by the UN Population Division to increase from just under 800 million in 2011 (representing 11% of world population) to over 2 billion in 2050 (representing 22% of world population)[1]



Population by age groups and sex

[1] United Nations Population Division (2011). World Population Prospects: The 2010 Revision. New York: UN Population Division

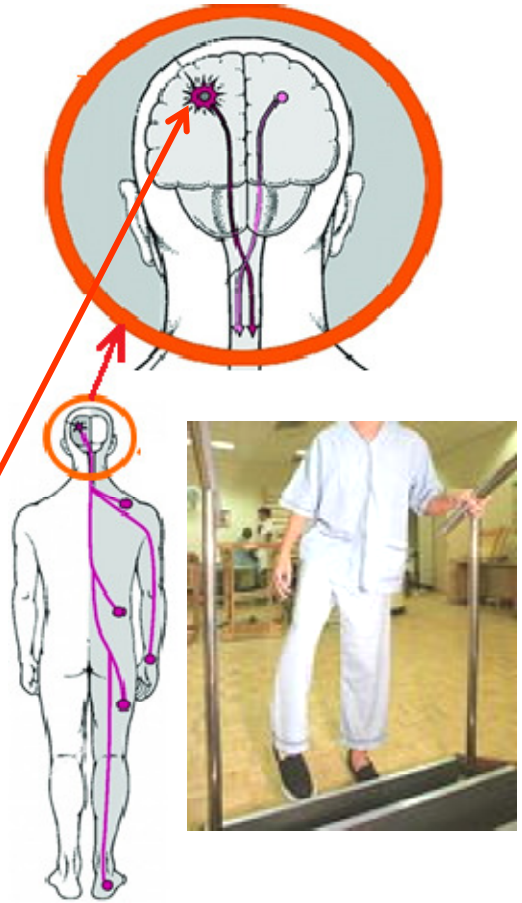
Background: Stroke and Aged People

- The aging population results in a tidal wave of NCDs (non-communicable diseases). Among them, stroke is the most common and rural frequent one.
- In China, morbidity and mortality of stroke is 2.5 and 1.5 million/year, respectively, and increase rate is 8.7% per year[1].
- Globally, the average morbidity and mortality of stroke is about 0.2% and 0.1% per year, respectively[2]. That means, there are about 12 million stroke incidences and about 6 million survivals every year in the world.

[1] http://roll.sohu.com/20120511/n342949706.shtml
[2] http://nxg.59yi.com/naoxueshuan/20101008/145178.html

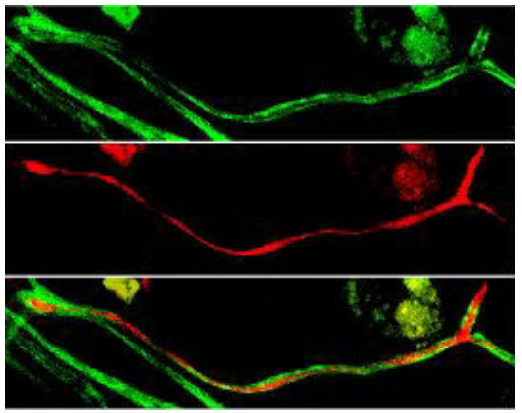
Background: Hemiplegia Caused by Stroke

- Among the stroke survivors, about 80% may suffer from paralysis. Up to date, the total numbers of stroke survivors in China and USA are about 7 million and 1.6 million, respectively. The estimation is >30 million globally.
- The reason that the paralyzed limb cannot function is because the source neurons in brain are damaged and no motor signal can be generated.

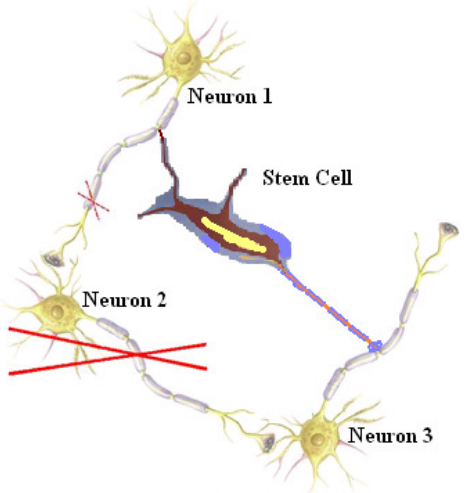


Biological Method for Neural Function Rebuilding: Cell Transplantation

- Cell Transplantation:
  1) Transplants of olfactory ensheathing cells into the injured spinal cords of laboratory rats had a remarkable capacity to repair damaged tissue and lay a 'bridge' across a gap in the injured nerve fiber
  2) Human neural stem cells differentiate and promote locomotor recovery in spinal cord-injured mice
- The problems:
  1) The improvement is perhaps not high enough
  2) A wrong function may be formed



olfactory ensheathing transplantation



stem cells bridge

- **Mechanic Technique for Motor Function Assistance: Orthosis and Exoskeleton**



The driven gait orthosis Lokomat

Advantages:

- ✓ Mature technique
- ✓ Noninvasive

Disadvantages:

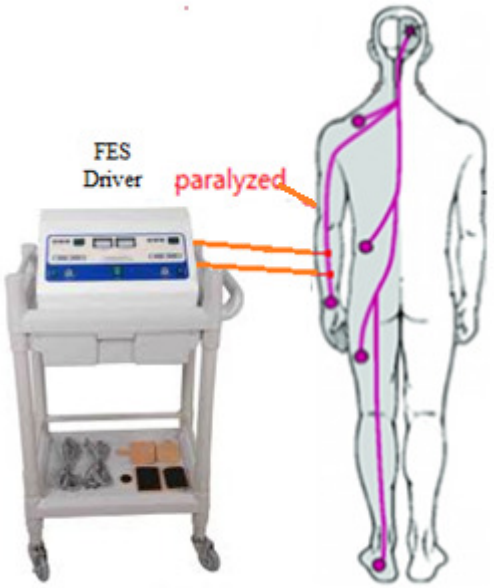
- ☐ Expensive because of the complexity,
- ☐ Large in size and heavy
- ☐ Energy waste not suitable for long time daily use.



Berkeley bionics eLEGS

Traditional Physical Therapies for Function Rebuilding of Paralyzed Limbs

- **Functional Electrical Stimulation (FES):**



Principle:

Stimulation with artificially coded pulses

Advantages:

Mature technique, noninvasive

Disadvantages:

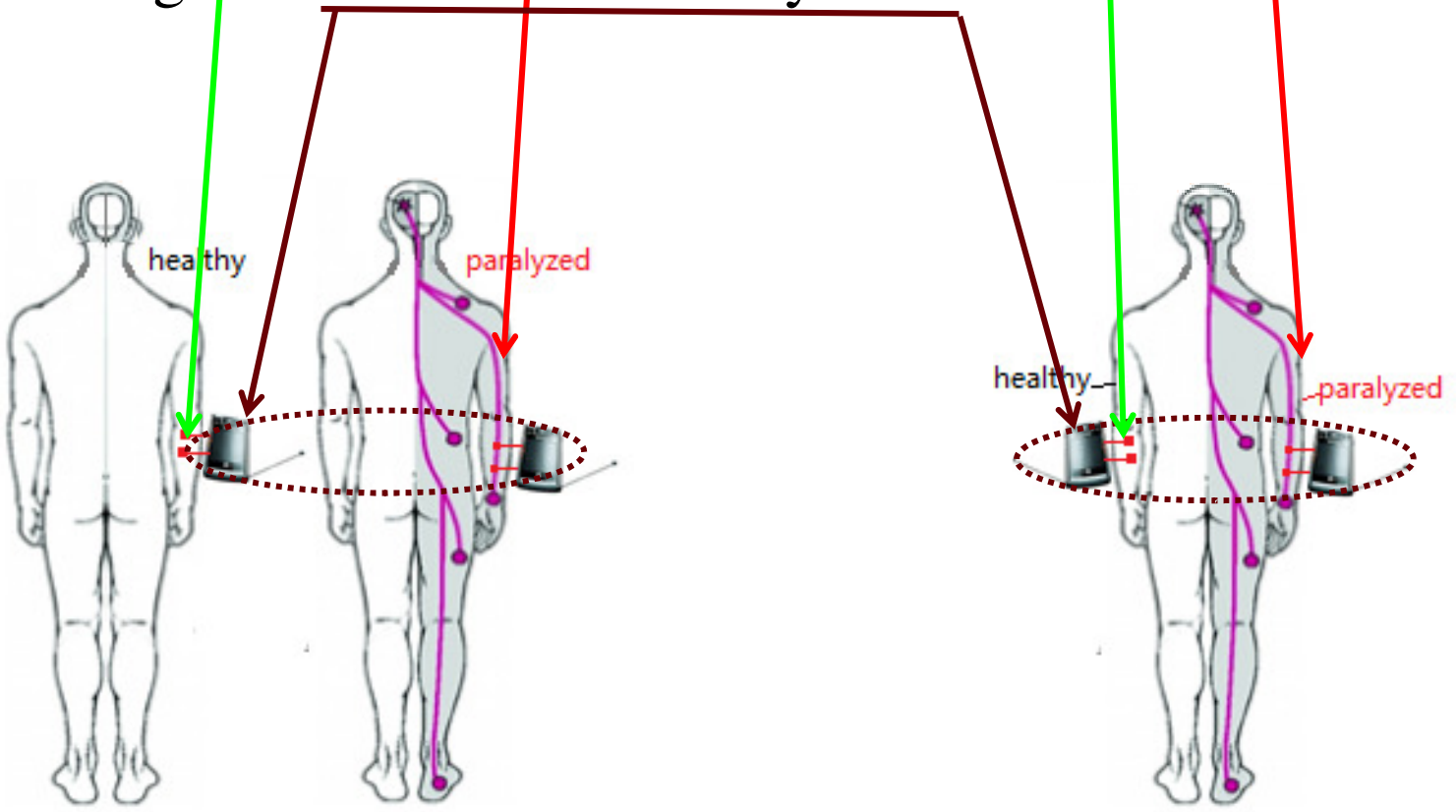
The action is more of periodic and mechanical, i.e. not natural enough.

(demonstration)

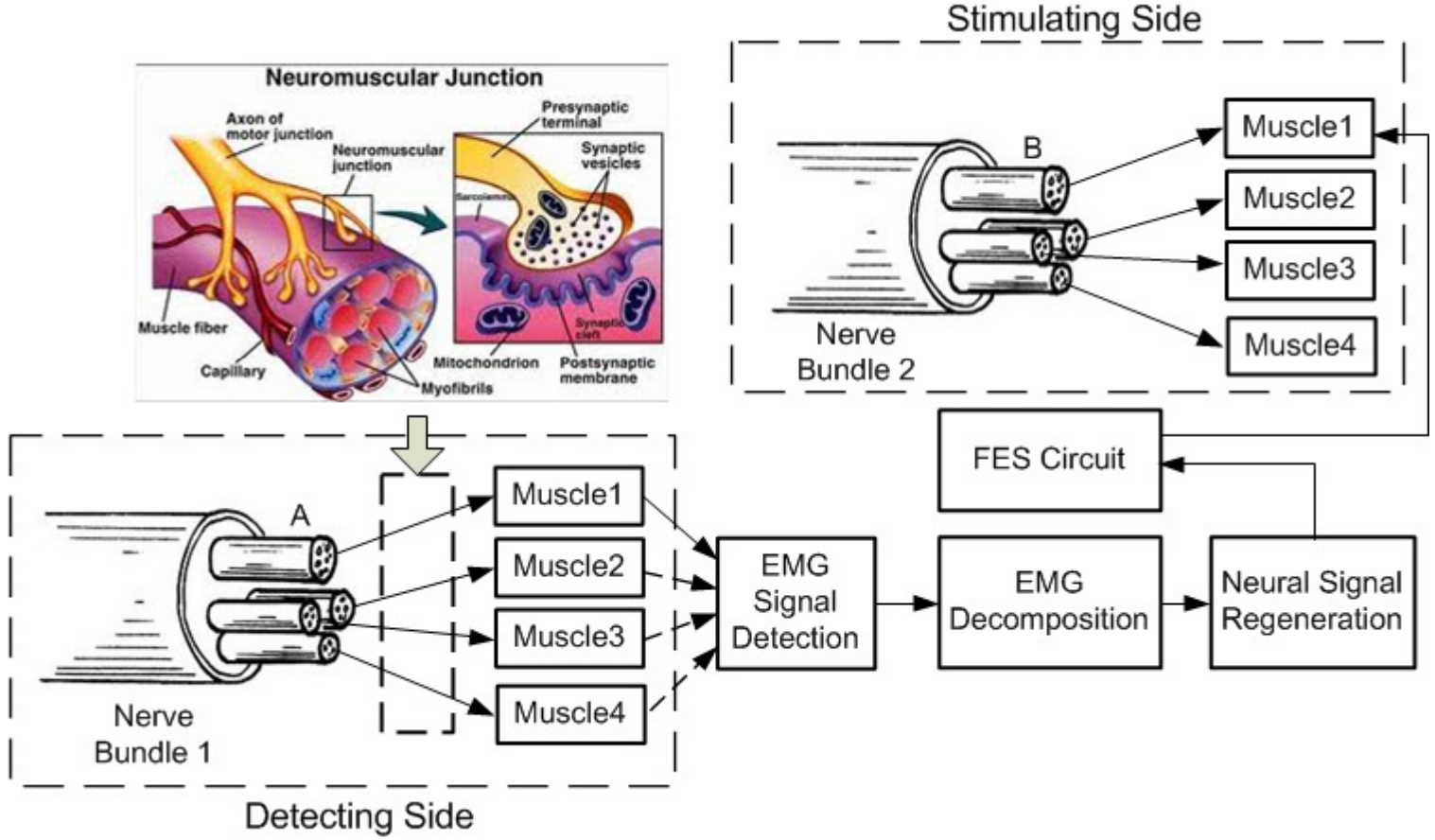


Our Concept to Rebuild the Function of a Paralyzed Limb

The controlling signal to the **nerves of a paralyzed limb** is obtained from **any limb of a healthy person** or **the contralateral healthy limb** and through an RF transmission system.

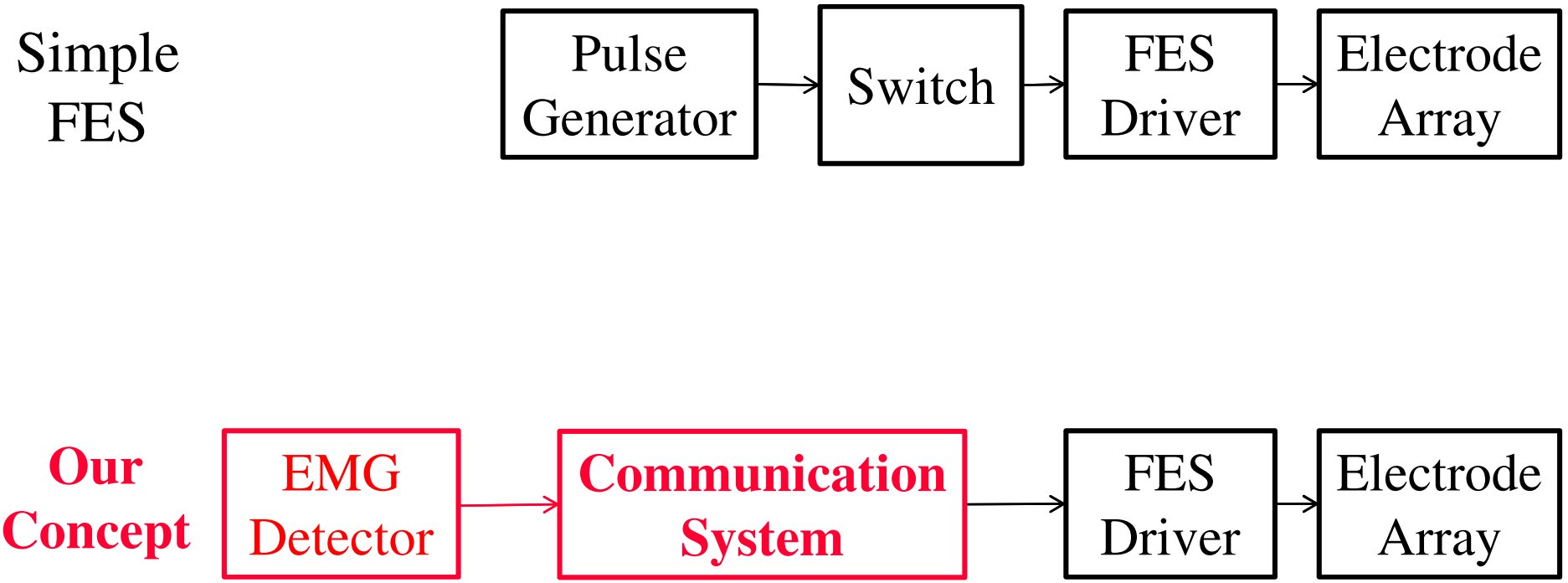


Principle Diagram of MENB (Micro-Electronic Neuro-Muscular Bridge)



EMG (electromyography) signals are used for restoration of limb locomotion.

Comparison of FES of today and our Concept



Prototype of Two Channel MENB

Surface Electrodes for EMG-



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