



# **The *AIDER* System and Its Clinical Applications**

**Authors: Yilin Wang, Hong Cheng\*, Jing Qiu, Anren Zhang, Hongchen He**

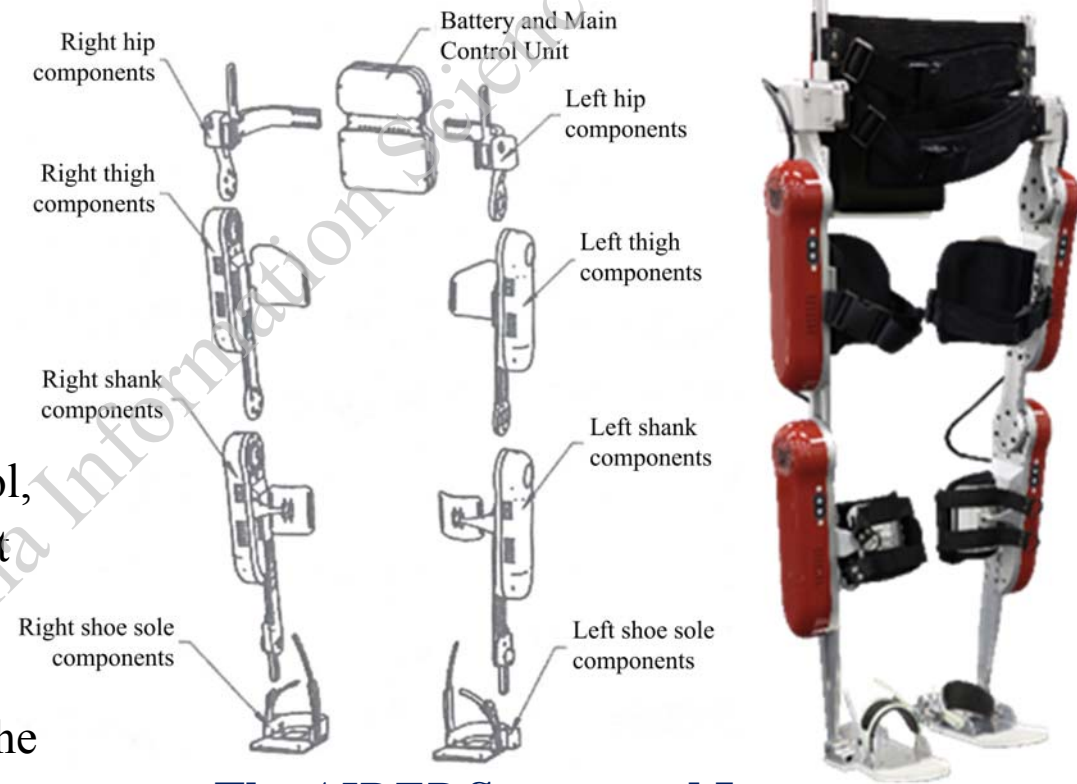
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- **The *AIDER* System**
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# The *AIDER* System

- The AIDER system is designed as a walking assistance device which is used to help the hemiplegia pilots standing, walking, climbing stairs and slope.
- AIDER is a physical coupled human-robot system which consist of pilots, wearable mechanical parts, sensors, motors, and computing devices.
- Through various techniques, such as human engineering, computing, control, and mechanics, AIDER can implement real-time perception, motor control, human-robot fusion, and information exchange through collaboration with the pilot.
- The pilots can select adaptable walking speed, gait length, and mode as needed.



**The *AIDER* System and Its structure**

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# Training Methods – Inclusion Criteria

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## Inclusion Criteria

- (1) Age: 15-75 years old
- (2) Injury: Spinal Cord Injury (SCI) plane is T6-L1
- (3) ASIA classification: A or B
- (4) Standing and walking ability: Need assistance of other device or standing frame to stand, but can't walking independently
- (5) The participants can understand the research contents and is willing to sign informed consent contracts

# Training Methods – Exclusion Criteria

Exclusion Criteria	
Modified Ashworth of both lower limbs	$\geq 2$
Blood pressure	Systolic pressure > 140mmHg or diastolic pressure > 90mmHg after drug control
	Uncontrollable postural hypotension
Joint	Contracture and deformity of the joints and tendons, such as arthroplasty, arthroplasty and so on
	Severe bone malformation and ligament rupture
	Unstable limb fracture
Body function	Complications or complications which will limit the patient's motor function
	Mental disease, hearing disorder, disturbance of comprehension
	Major organ failure or other serious diseases
	Pregnant, lactating women and who planning pregnancy
	Loss of spine stability
Range of SpO <sub>2</sub>	Static SpO <sub>2</sub> < 90%, and SpO <sub>2</sub> in motion < 88%
Venous problems of Lower extremity	Deep vein thrombosis of both lower limbs
Routine of blood, urine and stool	Routine of blood, urine and stool are abnormal, which are estimated unsuitable of this study
Other situations	Other situations that are estimated unsuitable of this study

# Training Methods

- 10 SCI subjects were selected for this study.
- The subjects used the *AIDER* system for gait training
  - ❑ Training project: 30min (a session)/day, 5 sessions/week, two weeks
  - ❑ Assessment measures of effectiveness: 6MWT(main), 10MWT, Hoffer, LEMS, SCIM, WISCI II
  - ❑ Assessment time: The first day before training, After one-week training (after  $7 \pm 2$  days) , After the two-week training (after  $14 \pm 2$  days)



Training with the *AIDER* system

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# The Subjects' Information

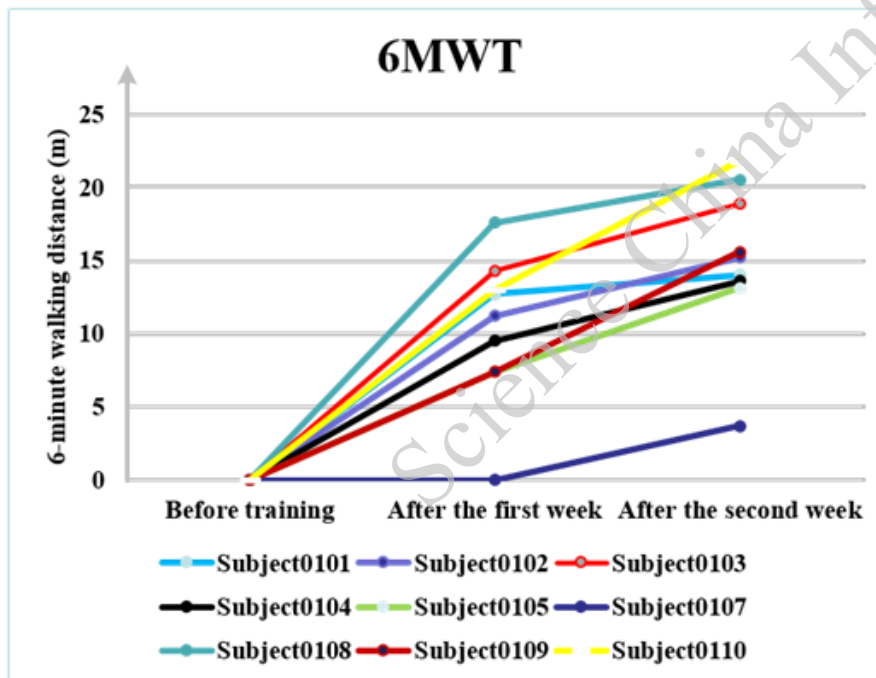
Subjects Number	Gender	Age	Height	Weight	ASIA	Injury Plane	Injury Months
0101	M	41	160cm	50kg	A	T9	4
0102	M	31	170cm	55kg	A	T6	10
0103	M	56	170cm	68kg	A	T11	4
0104	M	28	160cm	50kg	A	L1	4
0105	F	30	160cm	50kg	A	T8	84
0107	M	65	160cm	55kg	A	L1	24
0108	F	21	161cm	49kg	A	T12	48
0109	M	52	170cm	60kg	A	T9	120
0110	F	47	160cm	65kg	A	T10	180

➤ The No.0106 subject dropped out before training, so he was not in this table.

# The Results

➤ **6MWT** : The subjects walking 6 minutes as fast as possible and then measure the distance

Subjects Number	0101	0102	0103	0104	0105	0107	0108	0109	0110
First Visit	0	0	0	0	0	0	0	0	0
Second Visit	12.7m	11.2m	14.3m	9.5m	7.4m	0m	17.6m	7.4m	13.0m
Third Visit	14.0m	15.2m	18.9m	13.6m	13.1m	3.7m	20.5m	15.6m	21.8m

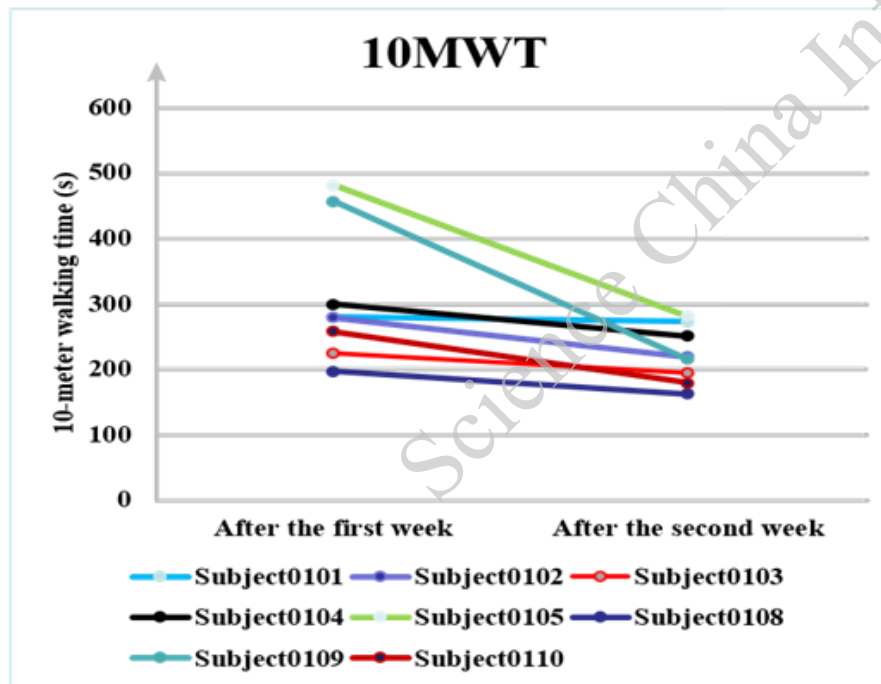


- From the results we can see that the distance of 6-minute walking increased after two-week training.
- After one-week training, the No.0107 subject still couldn't walk with *AIDER*. But this situation improved after two-week training and he could walk 3.7m with *AIDER*.

# The Results

➤ **10MWT** : The subjects walking 10 meters as fast as possible and then measure the time

Subjects Number	0101	0102	0103	0104	0105	0107	0108	0109	0110
First Visit	0	0	0	0	0	0	0	0	0
Second Visit	279s	278s	223s	298s	480s	180s (2.2m)	196s	455s	257s
Third Visit	272s	218s	194s	250s	280s	332s (2.5m)	161s	214s	178s



- Since we expected the results of 10MWT to be decreasing, the results of the first visit were not drawn in this figure.
- As the No.0107 subject only walked about **2m** (didn't finish the test), the results were not drawn in the figure.

# The Results

➤ **SCIM Score** : The higher the score, the better the spinal cord independence

Subjects Number	0101	0102	0103	0104	0105	0107	0108	0109	0110
First Visit	54	50	47	48	69	54	74	45	67
Second Visit	61	53	49	56	72	60	76	47	69
Third Visit	64	56	52	62	74	60	77	50	71

➤ **Hoffer** : Higher level indicated better walking abilities

Subjects Number	0101	0102	0103	0104	0105	0107	0108	0109	0110
First Visit	I	I	I	I	I	I	II	I	I
Second Visit	II	II	II	II	II	I	II	II	II
Third Visit	III	II	III	III	III	II	III	III	III

➤ **WISCI II** : 0 indicated can't walk; 9 indicated one can walk with walker and orthosis; 12 indicated one can walk with walker and didn't need other helps

Subjects Number	0101	0102	0103	0104	0105	0107	0108	0109	0110
First Visit	0	3	0	0	0	0	9	0	0
Second Visit	9	8	9	9	9	3	9	9	9
Third Visit	12	12	12	13	12	6	12	12	12

# The Results

## ➤ LEMS Score

Subjects Number	Flexor hip muscle		Stretch the knee muscle		Ankle back extensor		Big toe extensor		Gastrocnemius and soleus	
	left	right	left	right	left	right	left	right	left	right
0101	3	3	2	2	0	0	0	0	0	0
0102	0	0	0	0	0	0	0	0	0	0
0103	0	0	0	0	0	0	0	0	0	0
0104	1	1	0	0	0	0	0	0	0	0
0105	0	0	0	0	0	0	0	0	0	0
0107	2	2	0	0	0	0	0	0	0	0
0108	3	2	3	1	0	0	0	0	0	0
0109	0	0	0	0	0	0	0	0	0	0
0110	0	0	0	0	0	0	0	0	0	0

- LEMS score were the same in the three visits. Because the spinal cord is damaged due to the nerves cannot connected and this situation cannot improve through gait training.

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# Conclusions

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- We can see from the results that the walking ability and spinal cord independence were improved after two-week training with the *AIDER* system.
- The LEMS score stayed the same because the spinal cord is damaged due to the nerves cannot connected and this situation couldn't improve through gait training.
- There's no serious adverse event (SAE) occurs during training. Adverse events (AE) are in evitable in any clinical study (only one in this study).
- The *AIDER* system is safe and effective for gait training and walking assistance.



**Thank You !**

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