

# **MECHANICAL ENGINEERING**

TEXAS A&M UNIVERSITY

## **HUR (HUman Rehabilitation)**

**Group**  $\widehat{\Box}$  http://hurgroup.net

## INTRODUCTION

#### Motivation

- Falls-related injuries due to slip have been serious problems for workers and elderly adults [1].
- Debilitating factors for recovery from slip have not be clearly identified.
- Muscle synergy is a neural building block that compri of motor responses.
- Muscle synergies could have extracted muscle-specific contribution to balance and walking [2].

## **Objectives**

- To investigate a relationship between a subject's moto control strategy and the severity of slip.
- To find specific muscles that are related to the severe

#### Hypotheses

- For "severe slip" and "mild slip" group
  - (H1) There exists a significant difference between two groups for the role of synergies during slip.
  - (H2) There is no significant difference between two groups for the role of synergies during walk.

# METHODS

#### Subjects

11 healthy young adults (6 male, 5 female, age=22-33

#### Procedures

- Subjects were instructed to walk on a floor with four forceplates (Fig. 1).
- Right feet were ensured to hit first and third forceplat
- Four dry-walk trials preceded an unexpected slip trial.
- To induce unexpected slip, subjects were informed that the surface would be non-slippery.

## **Data Collection**

- Surface EMGs were measured from 8 leg muscles (Fig. 2)
- Forceplate data were collected.



Fig. 1 Plate setting and foot placements.

# **SLIP-RELATED MUSCLE SYNERGY DURING HUMAN WALKING**

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	EMG#	1	2	3	4	5	6	7	8
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een									
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3)	RESU	LTS							
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**Fig. 3** Synergy(left) and weight(right) for the slip trial.

There existed significant difference between the two groups' weight for <u>RF L</u> and <u>TA L</u> (shaded-region pointed by 1 in Fig 3).

RF L

TA L

ENG2 ENG3 ENG4 ENG5

02 03 0.4 0.5 0.6 0.7 0.8 0.9

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- The severity of slip potentially depends on activation/ deactivation patterns of two synergies (TA L and RF L).
- This implies that the severe slip group lacks stable support from the left leg by both RF L and TA L during slip.

## **Dry-Walk Trial Result**



For dry-walk trials, no significant difference was found between the two groups' weight.

C <sub>4</sub> MILD S	LIP GRO	0	C <sub>4</sub> SEVERE SLIP GROUP							
		l	- 0 <del>0</del> -					l		
-1 -1 r	15 20	25		5	10	15	20	25		

Fig. 5 A time step that the integration of TA R goes over 50% of total integration.

Mild slip group had greater muscle efforts of <u>TA R</u> in the earlier phase of gait cycle, compared to severe slip group, suggesting that mild slip group were more efficient in braking gait right after heel contact.

# CONCLUSION

- During slip, the different weight pattern of muscle synergy between two groups implies that the two groups employ different motor control strategy.
- The activation/deactivation time of TA L/R and RF L is potentially related to the severity of slip.
- As a future work, the effect of TA strengthening intervention on the changes of muscle synergy for severe slip group will be investigated.

## References

5 10 15 20 25

- [1] Beschorner et al., IIE Occ Ergo and Hum Fact, 1(1), p31-37, 2013
- [2] Chvatal and Ting, Frontiers in Computational Neuroscience, 7(48) p1-14, 2013











