MEDICAL UNIVERSITY OF VIENNA

ViennaFES | Cyber Sport Day 2025

Rules & Description v2025_08_14A

1. Introduction

A spinal cord injury (SCI) resulting in the complete loss of lower limb motor control leads to the degradation of the musculoskeletal system of the lower limbs, including muscle atrophy and loss of bone mineral density.

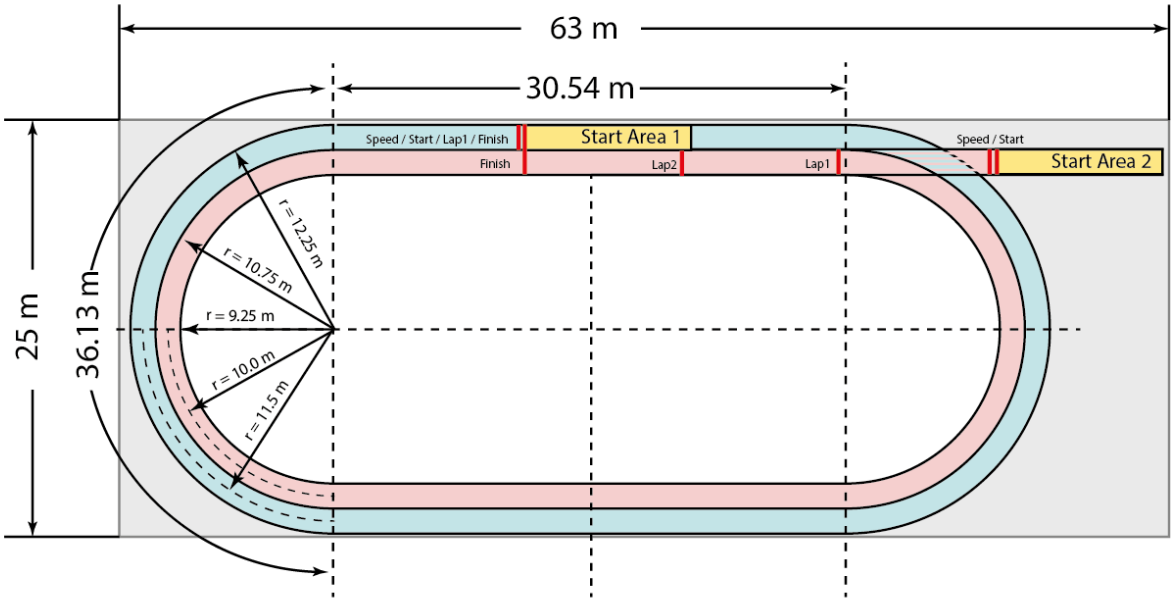
Functional electrical stimulation (FES) is a technology that uses electrical pulses to elicit action potentials in sensory and motor nerves, thus, exciting skeletal muscles that are paralysed. Regular FES cycling exercise after SCI has been shown to lead to beneficial physiological adaptations such as improvements in bone density, an increase of muscle mass, and improved muscular, cardiovascular and respiratory fitness. Besides the application of FES cycling in rehabilitation, it can be of high recreational value to people with SCI. Furthermore, FES can be combined with other assistive technologies such as powered exoskeletons. This allows merging the movement control advantages of a robotic device with the physiological benefits provided by FES. Furthermore, the use of FES hence bears the promising potential to counter some of the deleterious effects to the musculoskeletal system of the lower limbs after SCI, such as osteoporosis, decubitus or spasticity.

In this race the pilots are invited to participate in a 400 m midrange race on a flat asphalt track, with a rolling start, after conduction a start from stand-still within a specified starting area. In the starting area, the pilot might use his hands, arms or trunk to start from stand-still. The race and time measurement will be started after crossing the starting line. Please note, that the starting line has to be crossed at low speed (max. 5 km/h) and that further usage of the arms after the starting line is prohibited during the race.

2. Specifications:

Race location (GPS):	N48.219576, E16.344883
Track length:	133.33 m
Number of Laps:	3
Total race length:	400 m
Type of race:	Head-on-head race (2 pilots)
Race mode:	Best out of 3 races
Track material:	Asphalt
Track profile:	Mostly flat with slight inclines and declines (< ±1%)
Time limit:	5 min
Min. required average speed:	5.5 km/h
Starting area:	10 m
Max. speed at Start:	5 km/h

3. Race description



WarmUp
Prior to the race, pilots are encouraged to perform a warm-up routine in order to prevent potential injuries and prepare the muscles for the race. The warm-up procedure can either be performed stationary on a hometrainer or overground outside of the racing area. The warm-up procedure is not part of the race.

Starting procedure
The pilot must start from a stand-still position within a designated starting area. Inside the starting area, the usage of hands, arm or trunk is allowed to initiate the movement. The start needs to be performed exclusively by the pilot without the support of other team-members.

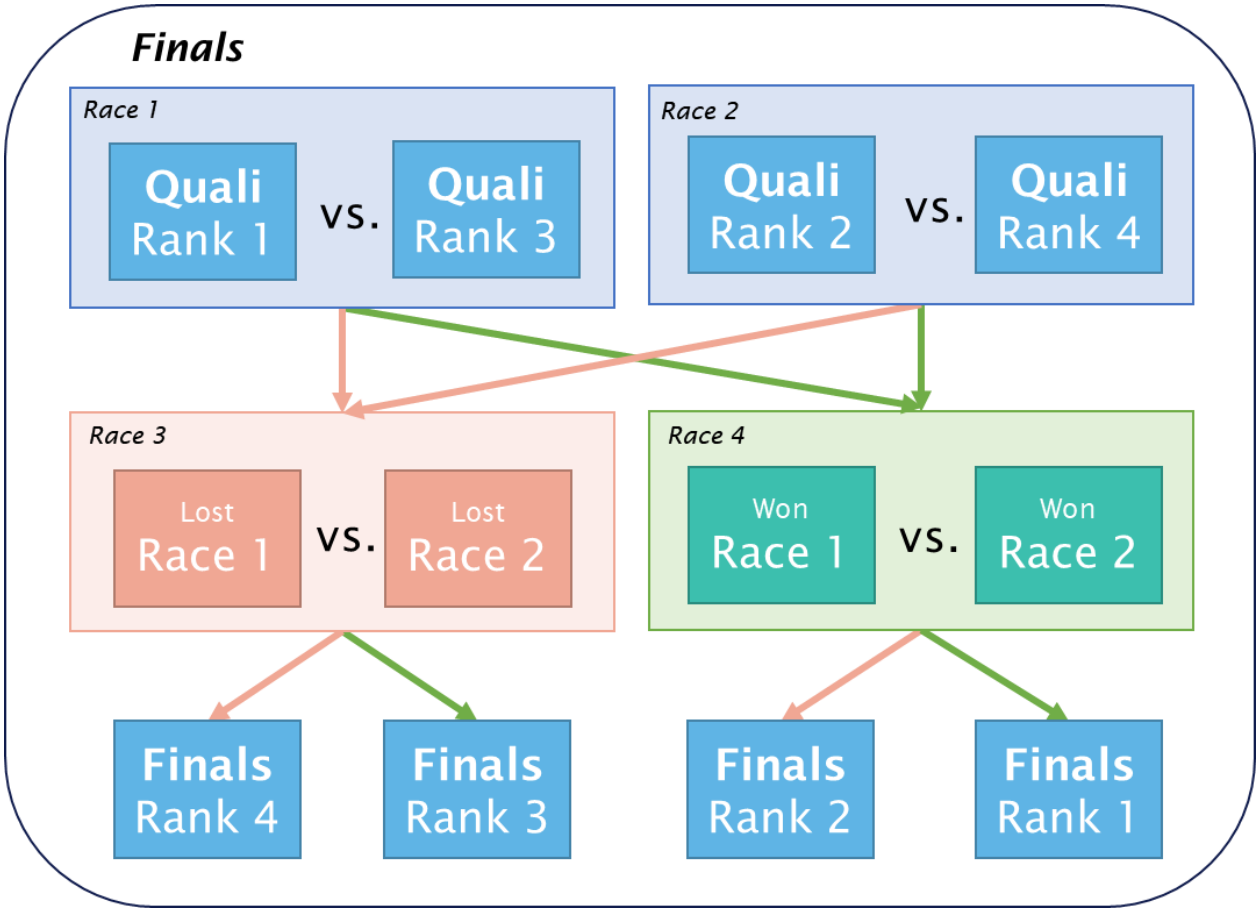
Race prodecure
After a clear audible start signal, pilots are allowed to initiate the starting procedure. The pilot should exit the starting area within 30 s. Please note that the START line has to be crossed at a low speed (max. 5km/h). The pilot has to cover a total of 3 laps within a time limit of 5 min. Time measurement starts when the first wheel is crossing the START line. The time measurement stops when the first wheel is crossing the FINISH line or when the time limit is reached.

The race track is divided into 20 segments of equal distance (i.e. 10 segments per lap). In case the pilot did not finish the entire length of the track within the specified time limit, the last segment successfully covered will be counted. Each segment covered will be scored 5 Points, amounting to a total of 100 Points. All pilots will be ranked according to the points achieved. In case of equal points, the time required will determine the ranking. In case of equal points and time, the pilots will be assigned the same rank.

Qualification
Each pilot will be allowed a total of 3 runs. For the ranking only the best run is counted.

Finals

The four highest-ranked pilots from the qualification will be invited to the final races. The finals will follow a knockout format. Based on the qualification ranking, Rank 1 will compete against Rank 3, while Rank 2 will compete against Rank 4. The winners of these races will advance to the final to determine 1st and 2nd place. The remaining two pilots will compete in a separate race to determine 3rd and 4th place.



4. Detailed Rules

Team Rules

TEAM-1 A team must consist of a technology provider and at least one pilot. Each team must be managed by a team manager, which can be the pilot or technology provider. All team members are responsible for adhering to the following rules to ensure a safe and fair competition. Failure to comply may result in a race not being counted or, in severe cases, the disqualification of a pilot or the entire team.

TEAM-2 The team is responsible for checking the device function and health status of its pilot and apply highest safety standards for everyone involved in the race.

TEAM-3 Participation must be safe for the pilot at any time. The team is responsible for guaranteeing safety at all time.

TEAM-4 When registering for the competition, the team agrees that all data collected by the organizers during the race, will be shared with other participating teams on request.

TEAM-5 Each team participates at its own risk. The organizers are not responsible for any injuries or damages that may occur during the event. Teams are advised to obtain appropriate insurance coverage.

TEAM-6 In the finals, each pilot must compete with their own cycling device. If multiple pilots from the same team qualify using the same device, only the higher-ranked pilot will be admitted. However, if the team provides separate cycling devices, multiple pilots may participate in the finals.

Pilot Rules

PILOT-1 Each pilot must reach legal age in their home country on the day of the race trial.

PILOT-2 Each pilot must have sufficient cognitive and communicative abilities to understand the Races & Rules and to follow the instructions of the team members and the referee.

PILOT-3 The pilots must have a spinal cord injury with paraplegia or tetraplegia and a complete loss of motor function in the lower limbs (ASIA AIS A or B, http://www.sci-info-pages.com/levels.html). For each pilot, a confirmation about ASIA score, level of lesion and fitness to race must be provided by a medical doctor, prior to the race. There will be no medical check performed directly before the race. However, we expect all teams to adhere to the highest levels of fairness.

PILOT-4 The pilot must have sufficient stability to safely control the cycling device. A pilot with tetraplegia is eligible if the lesion does not affect the ability to safely operate the cycling device.

PILOT-5 If an assistive device (or (a) component(s) thereof) is implanted in the pilot's body (e.g., electrodes, sensors, osseointegration), the implants must be medically stable for at least six months and free of complications (e.g., infections) prior to and at the time of the competition. If the implanted assistive device or parts thereof are research prototypes, the team must have approval of the responsible regulatory body governing the institution of the participating team. At the time of the competition the approval must be valid, and it must cover all situations and activities connected with participation in the competition.

Technology Rules

TECH-1 The cycling device must be safe for the pilot and the environment at any time. The pilot has to wear a helmet during the race. Additional protective equipment might be used if necessary. The team is fully responsible for guaranteeing safety at all time.

TECH-2 The cycling devices can have an arbitrary number of wheels, thus, including bicycles, trikes, 4-wheeled vehicles, etc., provided it is safe for the pilot.

TECH-3 The cycling devices and all attached components must be designed to function safely in wet conditions. Since the competition is an outdoor event, the cycling device should be capable of operating safely in light drizzle or on a wet race track. In the event of heavy rain, the race may be postponed, relocated, or canceled.

TECH-4 The pilot must be able to emergency stop the assistive device at any time.

TECH-5 Any technology that stimulates the neuromuscular structures of the lower limbs and/or other neural structures is allowed. This includes also implanted systems. The IEC standards 60601-1 and 60601-2-10 (or similar regulations applied in the country of development), describe particular requirements for the basic safety and essential performance of transcutaneous nerve and muscle stimulators provide a helpful guideline to manufacture a safe stimulator. Compliance with 60601-1 and 60601-2-10 (or similar regulations applied in the country of development) is recommended for prototypes.

TECH-6 The cycling device, stimulator, control units, batteries and any other technology used must be safe. The FES stimulator must fulfil the standard regulations for electrical safety, which are common in the region of the team.

TECH-7 Any number of stimulation channels, control strategy or stimulation pattern can be applied to stimulate muscle groups, single muscles or fractions of muscles provided it is safe for the pilot.

TECH-8 The FES stimulators can apply closed-loop control strategies using sensors applied to the pilot or the cycling device. The pilot is also allowed to manually trigger the stimulator.

TECH-9 All components (e.g., FES stimulator, control units, batteries, tools, spare parts or similar) that are used during a race must be attached to the cycling device or the pilot from the start to the end of the race.

TECH-10 Cycling devices may only be powered by the pilot's fully paralyzed legs, exclusively activated through FES. Muscles under any volitional or partial volitional control by the pilot are not permitted for propulsion (exception see FES-10a and FES-10b). It is not allowed to physically support the pilot by any other person or other devices (e.g., pacemaker-vehicle).

TECH-10a Although the use of the hands, arms or trunk is strictly prohibited for general propulsion during the race, they might be used sporadically for a maximum of 5 single pushes to overcome dead-points. Extensive use or any other misuse of hand, arm or trunk pushes is not allowed and will lead to rejection of the race attempt.

TECH-10b If a pilot gets stuck at any point during the race (e.g. due to fatigue or malfunction of the cycling device), the pilot is allowed to take a short break while the time measurement continues. A restart must be performed exclusively by the pilot, without external physical support. Hands, arms and trunk might be used to facilitate the restart from standstill for a maximum distance of 10 m.

Race & Scoring

RACE-1 The race track will be divided into 10 sections per lap. For each section 5 Points will be granted, amounting to a total of 100 points for completing the full race length.

RACE-2 The time to cover the required distance will be measured. The time to complete the race will be measured to the tenth of a second.

RACE-3 The time measurement will start after the first wheel of the cycling device touches the start line and it will stop after the first wheel of the cycling device touches the finish line or the specified time limit is reached.

RACE-4 In case the pilot does not finish within the specified time limit, only the last section successfully past will be counted.

RACE-5 Overtaking another pilot is permitted, provided it does not impede or obstruct the other pilot. Risky or unsporting behavior is prohibited. The safety of both pilots and the environment must always be ensured.

RACE-6 All pilots will be ranked according to the points achieved. In case of equal points, the time required will determine the ranking. In case of equal points and time, the pilots will be assigned the same rank.

RACE-7 In the qualification, each pilot will be allowed 3 runs, counting only the best run.

RACE-8 The four best ranked pilots of the qualification, will be allowed to race in the finals.

RACE-9 During a race, the pilot and its assistive device must neither be supported nor blocked by an accompanying person, or any other person or a service animal. Remote control of the assistive device by any person other than the pilot is also not allowed.

RACE-10 A race will not be counted, if the team or pilot does ignore any of the rules, shows serious unsporting behavior or generates other serious disturbance.