Instrumentation of sprint and long jump tracks of an indoor athletics field to study athletes' performances

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Introduction: The in-depth study of the performances of athletes is crucial to evaluate and improve their technique. However, collecting representative data is not trivial, as several factors could affect the measurements. Laboratory measurements can lack in realism (artificial environment, athlete's lack of challenge), whereas data collected in-field using on-board devices can be influenced by the instrumentation itself (weight, encumbrance) [1-2].
The aim of this work is the design of an instrumented track, which will allow to collect kinematic and kinetic data of able bodied and paralimpic athletes in their natural environment, ensuring that the influence of the sensory apparatus is negligible.
Methods: The instrumentation set-up of the indoor athletics track of Padova (Padova, 35136, Italy) is represented in the plan view of figure 1a. Seven 60x90 cm and two 40x60 cm force platforms (AMTI, BMS600900 and BMS400600) will be installed following the disposition depicted in figure 1b on the eighth lane of the sprint track, leading to a total of 6.9 metres of force sensing lane. The two smaller force platforms will be installed side-by-side to allow the possibility of mounting one single starting block on each force transducer to collect separate right and left ground reaction forces during the starting phase of sprinting. An additional 60x90 cm force platform will be installed on the long jump track at 1.6 metres from the sand pit in order to collect the last step of the athlete before the flight phase of the long jump (figure 1c).
Kinematic data will be collected using 10 optoelectronic motion capture cameras (Vicon, Vantage5), which will be installed on a double portal structure made of aluminium trusses with an overall size of 13 x 7 x 3.5 metres (length x width x height). The structure size allows more than one athlete to run simultanesously, in order to recreate the "challenge effect" typical of official races.
Compared to other motion capture mounting solutions, such as using tripods to support each individual camera [3], the use of this single support structure offers the advantage of allowing to rigidly translate the motion capture calibrated volume in different part of the athletics field using wheels. This feature reduces drastically the set-up time of the motion capture system, particularly when the data collection focus has to be moved between the sprint and the long jump area.

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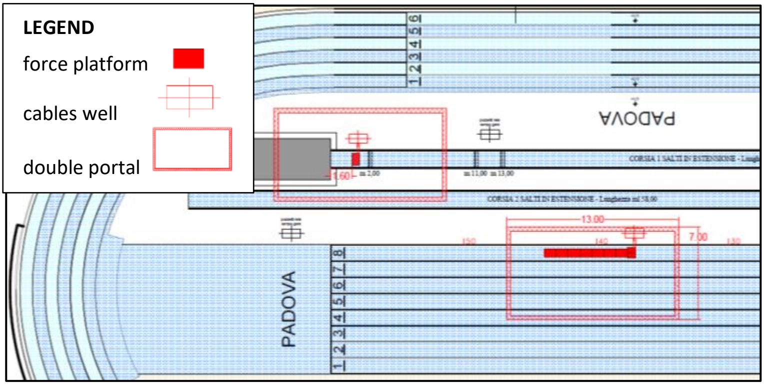
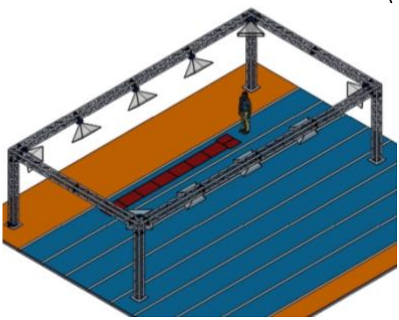
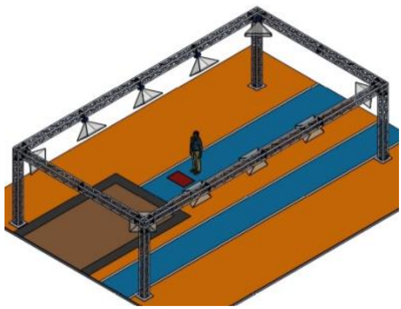
Moreover, this structure allows to avoid the presence of any cable on the track, as wires will pass through the trusses and descend via the vertical columns.



(a)



(b)



(c)

Fig. 1: Instrumented athletics track. (a) overall plan view, (b) detail view of the sprint track, (b) detail view of the long jump track.

Results and discussion: The design of the sensorized athletics track is complete and the installation of the instrumentation will take place in the next few months. This track will allow to collect insightfull in-field data regarding able bodied and paralimpic athletes performances outside the laboratory environment. Examples of these data will be presented in June at the ISEA 2022 conference.

1. Petrone Nicola, Gianfabio Costa, Gianmario Foscan, Antonio Gri, Leonardo Mazzanti, Gianluca Migliore, and Andrea Giovanni Cutti (2020), Development of Instrumented Running Prosthetic Feet for the Collection of Track Loads on Elite Athletes, Sensors (Switzerland) 20 (20): 1–18.
2. Fuss Franz Konstantin (2009), Instrumentation of Athletes and Equipment during Competitions, JST 1 (6): 235–36.
3. Brüggemann Gert-Peter, Adamantios Arampatzis, Frank Emrich, and Wolfgang Potthast (2008), Biomechanics of Double Transtibial Amputee Sprinting Using Dedicated Sprinting Prostheses, JST 1 (4–5): 220–27.

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