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OBJECT
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This document contains supplementary material for the article “Collection of kinematic and kinetic data of young & adult, male & female subjects performing periodic and transient gait tasks for gait pattern recognition” (Authors: Paolo Mistretta, Cecilia Marchesini, Andrea Volpini, Luca Tagliapietra, Tommaso Sciarra, Aldo Lazich, Salvatore Forte, Mauro De Matteis, Emanuele Menegatti and Nicola Petrone) presented at the 13th conference of the International Sports Engineering Association, Tokyo, Japan, 22-25 June 2020.

Data are contained in the file: “database_ISEA2020.mat”

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CONTENT OF THE DATABASE
This sample dataset includes data relative to 5 repetitions of 4 different subject belonging to the 4 different populations analyzed, performing 16 gait task.

The 4 population analyzed are described in table 1.

Table 1. Population analyzed

| Name           | Code | Numerical identifier | Inclusion criteria                  | Population average (mean±SD) |
|----------------|------|----------------------|-------------------------------------|-------------------------------|
| Young Male     | YM   | 1XX                  | male, 20-35 years old               | age: 25.6 ± 1.8 y; height: 1.86 ± 0.06 m, weight: 76.9 ± 8.3 kg |
| Young Female   | YF   | 2XX                  | female, 20-35 years old             | age: 25.4 ± 2.9 y; height: 1.69 ± 0.06 m, weight: 58.3 ± 4.0 kg |
| Adult Male     | AM   | 3XX                  | male, 40-60 years old               | 48.2 ± 7.1 y; height: 1.77 ± 0.08 m, weight: 74.8 ± 9.8 kg |
| Adult Female   | AF   | 4XX                  | female, 40-60 years old             | age: 49.3 ± 6.1 y; height: 1.62 ± 0.06 m, weight: 55.8 ± 8.2 kg |

The 16 gait tasks studied are reported in table 2.

Table 2. Gait tasks collected in the database

| Type          | Name                | Trial code | Description                                                                 |
|---------------|---------------------|------------|-----------------------------------------------------------------------------|
| Periodic      | Level walk neutral  | P_NW       | Walking over ground at self-selected speed                                  |
|               | Level walk slow     | P_SW       | Walking over ground at self-selected slow speed                             |
|               | Uphill walk         | P_UW       | Walking uphill on a +10° inclined ramp                                      |
|               | Downhill walk       | P_DW       | Walking downhill on a -10° inclined ramp                                    |
|               | Stair up            | P_SU       | Climbing up stairs (step height: 170 mm; step width: 280 mm)                |
|               | Stair down          | P_SD       | Climbing down stairs (step height: 170 mm; step width: 280 mm)             |
|               | Standing            | P_ST       | Standing on both feet in a natural position                                 |
|               | Sitting             | P_SI       | Sitting on a chair                                                          |
|               | Sit to stand        | T_SI_ST    | From sit to stand                                                           |
|               | Stand to sit        | T_ST_SI    | From stand to sit                                                           |
|               | Stair up to stand   | T_SU_ST    | From climbing up stairs to stand                                           |
|               | Stand to stair down | T_ST_SD    | From stand to climbing down stairs                                          |
|               | Stand to stair up   | T_ST_SU    | From stand to climbing up stairs                                           |
|               | Stair down to stand | T_SD_ST    | From climbing down stairs to stand                                          |
|               | Level walk to stair | T_NW_SU    | From over ground walk to climbing up stairs                                |
|               | Stair down to level | T_SD_NW    | From climbing down stairs to over ground walk                               |

Note: All trials are at self-selected speed.
PROCESSING PROTOCOL

For the development of this database the “Helen Hayes MM” processing protocol has been used, derived from the studies of Kadaba and Davis [1-2]. The protocol relies on 22 reflective markers to build the “static” biomechanical virtual model, and on 18 to build the “dynamic” one.

The scheme of the marker locations is showed below for both the “static” (left) and the “dynamic” (right) model.

STRUCTURE OF THE DATABASE

The file “database_ISEA2020.mat” is organized in the following manner:

- Each trial contains the following data:
  - “subj_code”, subject code (see table 1);
  - “trial_code”, trial code (see table 2);
  - “trial_number”, trial number (from 00 to 04);
  - “anthropometry”, anthropometry of the subject;
    - “mTB”, mass [kg];
    - “dTH”, height [m];
“gait_cycle”, gait cycle temporal parameters;
- “gait_time”, stride time [s];
- “rTO_time”, toe off of the right leg [s];
- “rTO_perc”, toe off as a percentage of the gait cycle [%];

“ang”, joint and body segment angles;
- “jRAtb”, right ankle 3D joint angle;
  - “time”, time of the frame, native framerate of 250 Hz [s];
  - “perc”, percentage of the gait cycle of the frame, native framerate of 250 Hz [%];
  - “x”, “y”, “z”, inversion/eversion, abduction/adduction and flexion/extension joint angle respectively, native framerate of 250 Hz [deg];
  - “time_res”, time of the frame, interpolated on 100 points [s];
  - “perc_res”, percentage of the gait cycle of the frame, interpolated on 100 points [%];
  - “x_res”, “y_res”, “z_res”, inversion/eversion, abduction/adduction and flexion/extension joint angle respectively, interpolated on 100 points [deg];
- “jRkb”, right knee joint angle (same sub-fields as “jRAtb”);
- “jRHp”, right hip joint angle (same sub-fields as “jRAtb”);
- “jLAtb”, left ankle joint angle (same sub-fields as “jRAtb”);
- “jLkb”, left knee joint angle (same sub-fields as “jRAtb”);
- “jLHp”, left hip joint angle (same sub-fields as “jRAtb”);

“absangRT”, absolute Euler angles of the right thigh with respect to the gait system of reference (SoR)*
  - “time”, time of the frame, native framerate of 250 Hz [s];
  - “perc”, percentage of the gait cycle of the frame, native framerate of 250 Hz [%];
  - “x”, “y”, “z”, Euler X, Y and Z angles of the sequence XYZ, native framerate of 250 Hz [deg];
  - “time_res”, time of the frame, interpolated on 100 points [s];
  - “perc_res”, percentage of the gait cycle of the frame, interpolated on 100 points [%];
  - “x_res”, “y_res”, “z_res”, Euler X, Y and Z angles of the sequence XYZ, interpolated on 100 points [deg];
- “absangRC”, absolute Euler angles of the right calf with respect to the gait SoR* (same sub-fields as “absangRT”);  
- “absangRF”, absolute Euler angles of the right foot with respect to the gait SoR* (same sub-fields as “absangRT”)
- “absangLT”, absolute Euler angles of the left thigh with respect to the gait SoR* (same sub-fields as “absangRT”);  
- “absangLC”, absolute Euler angles of the left calf with respect to the gait SoR* (same sub-fields as “absangRT”);  
- “absangLF”, absolute Euler angles of the left foot with respect to the gait SoR* (same sub-fields as “absangRT”);  

“angvel”, joint and body segment angular velocity [deg/s] (same structure of “ang”);  

“torque”, joint 1D torque;
- “tRAFE”, right joint ankle flexion/extension torque;
  - “time”, time of the frame, native framerate of 250 Hz [s];
  - “perc”, percentage of the gait cycle of the frame, native framerate of 250 Hz [%];
  - “data”, flexion/extension torque, native framerate of 250 Hz [Nm];
  - “time_res”, time of the frame, interpolated on 100 points [s];
  - “perc_res”, percentage of the gait cycle of the frame, interpolated on 100 points [%];
  - “data_res”, flexion/extension torque, interpolated on 100 points [Nm];
- “tRKFE”, right joint knee flexion/extension torque (same sub-fields as “tRAFE”);
- “trHFE”, right joint hip flexion/extension torque (same sub-fields as “tRAFE”);
- “tLFE”, left joint ankle flexion/extension torque (same sub-fields as “tRAFE”);
- “tLKFE”, left joint knee flexion/extension torque (same sub-fields as “tRAFE”);
- “tLHPFE”, left joint hip flexion/extension torque (same sub-fields as “tRAFE”);

“power”, joint 1D power [W] (same structure of “torque”);

“imu_acc”, virtual IMU 3D linear acceleration;
- “rIMUP acc g rel”, IMU virtually located on the right calf [m/s^2];
- “rIMUPs acc g rel”, IMU virtually located on the left calf [m/s^2];

“imu_angvel”, virtual IMU 3D angular velocity;
- “rIMUP angvel rel”, IMU virtually located on the right calf [deg/s];
- “rIMUPs angvel rel”, IMU virtually located on the left calf [deg/s];

“reference”, different systems of reference with respect to the LAB SoR*;
- “rGAIT”, gait SoR*;
  - “time”, time of the frame, native framerate of 250 Hz [s];
• “x”, “y”, “z”, coordinates of the center of the SoR, native framerate of 250 Hz [m];
• “rpx”, “rpy”, “rpz”, Euler Z, Y and X angles of the sequence ZYX, native framerate of 250 Hz [rad];
• “time_res”, time of the frame, interpolated on 100 points [s];
• “x_res”, “y_res”, “z_res”, coordinates of the center of the SoR, interpolated on 100 points [m];
• “rpx_res”, “rpy_res”, “rpz_res”, Euler Z, Y and X angles of the sequence ZYX, interpolated on 100 points [rad];
- “rRT”, right thigh SoR (same sub-fields as “rGAIT”);
- “rRC”, right calf SoR (same sub-fields as “rGAIT”);
- “rRF”, right foot SoR (same sub-fields as “rGAIT”);
- “rLT”, left thigh SoR (same sub-fields as “rGAIT”);
- “rLC”, left calf SoR (same sub-fields as “rGAIT”);
- “rLF”, left foot SoR (same sub-fields as “rGAIT”);
1. Kadaba, M.P.; Ramakrishnan, H.K.; Wootten, M.E. Measurement of Lower Extremity Kinematics During Level Walking. *Journal of Orthopaedic Research*, 1990, doi: 10.1002/jor.1100080310

2. Davis, R.B.; Öunpuu, S.; Tyburski, D.; Gage, J.R. A gait analysis data collection and reduction technique. *Human Movement Science*, 1991, vol.10, pp.575-587, doi: 10.1016/0167-9457(91)90046-Z.