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ALLADIN
Natural Language Based Decision Support in Neuro-rehabilitation

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PRIORITY 2.3.1.11

DELIVERABLE 4.1:
DATA DEFINITION FOR PATIENTS, TOOLS FOR ELIMINATION OF NOISY DATA AND SOFTWARE FOR DATA PRE-PROCESSING AND DESCRIPTION OF DATA MINING ALGORITHMS

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RESUME

The aim of this document is twofold:

- *to provide a synthetic presentation of the rationale that guided the design and development of the ALLADIN Pre-Processing Tool (APT) that represents Deliverable D4.1 of the ALLADIN Project;*
- *to describe the functional architecture of the APT and the basic guidelines for operation of the APT Software Package, that is available in the CD ROM enclosed with this document.*

Deliverable D4.1 is the main outcome of Task T4.1 'Data definition for patients, tools for elimination of noisy data and software for data pre-processing', *led by Scuola Superiore Sant'Anna (SSSA).*

The APT has been developed in MATLAB environment. It allows to the user to download from the ALLADIN Global Database the data measured with the ALLADIN Diagnostic Device (ADD) by the three clinical groups during the ongoing ALLADIN clinical trials, and it performs three basic operations:

- *Visualization. All the Force/Torque (F/T) measurements can be easily plotted for visual inspection by the user. This operation is of paramount importance for physiological interpretation of the isometric measurements, and it has been already widely used all along the APT development to guide the selection of the appropriate filtering techniques and of the meaningful features to be extracted;*
- *Filtering. Two-channel parallel low-pass filtering at 40Hz and 2Hz, has been implemented. The 2Hz-channel is mainly devoted to visualization purposes and to the estimation of the time of activation (onset time) of the different sensors, i.e. the time when the sensor starts recording a signal which can be considered related to human voluntary isometric contraction. Measurements data are recorded by the ADD over time windows of a few seconds, so that accurate estimation of the onset time is essential to reduce the amount of data to be pre-processed by using a smaller time window than the whole recording window. Different techniques have been implemented to produce best-estimate of the onset time, and a specific technique has been selected after comparative analysis with sample data manually elaborated by the clinical experts.*
- *Feature extraction. A set of statistical parameters on the resultant force and torque vectors over time, and time of activation of the different sensors within the same task execution are computed for all pre-processed recordings, with the exception of the 2nd Attempt of each task (Imagination), which has been considered of no clinical value. Signal analysis is limited to a time window of 300 ÷500 msec after sensor activation.*

The APT is a research tool which is not specifically meant, at this stage of the project, for on-field clinical use by therapists and other clinical operators not directly involved in the experimental analysis of the ALLADIN clinical data. Nevertheless, the APT functional architecture has been already conceived in view of its possible upgrade to a more user-friendly version, featuring a high-level interface providing access to current APT functions and some additional functions for management of clinical data.

This deliverable has been developed during the second year of the ALLADIN project (Months 13 to 24) by the WP4/T4.1 Team directly joined by five Alladin partners (Multitel, UCBM, AHS, ULFE, BUTE) and also by an external research group at KU Leuven, with specific expertise in data mining and signal processing. According to the ALLADIN multidisciplinary approach, T4.1 has been carried out in tight co-operation with the project co-ordinator but also asking feedback for the validation of the proposed pre-processing techniques by the other ALLADIN clinical partners (AHS, NIMR,TCD). The participation to this effort of the Multitel and KUL research groups was the result of a remediation plan for coping with the termination of the participation of Cardiff University (CU), the former WP4 Leader, to the ALLADIN Consortium. The final approach selected for the design and development for the pre-processing of the clinical data is mainly based on the specific inputs received by Multitel and KUL in the last quarter of the second year of the project. This should guarantee a smooth subsequent application of the selected data mining techniques to the pre-processed data for the extraction of markers and milestones of the recovery process.

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