"DINAMSOFT 1.0": A SOFTWARE FOR 3D BIOMECHANICAL ANALYSIS OF STANDARD FORCE TRAINING EXERCICES AND WEIGHT LIFTING

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The package "DinaSoft 1.0" is a software, developed in MATLAB environment, based in 3D Inverse Dynamics. It also includes special designed modules for Digital Signal Processing, EMG analysis and Stabilometry. It admits data obtained from different commercial electronic systems and instruments and after processing allows technical and scientific staff to obtain feasible information concerning biomechanics and motor control of the standard fitness, training and rehabilitation exercises.

KEY WORDS: motor control, biomechanics, inverse dynamics, strength, strength training.

INTRODUCTION: Strength training is a very important part of training, fitness and rehabilitation processes (Escamilla, 2001). In this sense, fitness, training and rehabilitation programs include a variety of exercises. However, there are inter- and intra-differences concerning Kinematics and Kinetics of the motor patterns during the performance of a series exercises. Thus, there are differences concerning the mechanical consequences of the motor patterns on the joint structures and elements. On the other hand, load´s standardization in terms of 1RM fails to characterize completely the level of the developed mechanical load. Finally, the motor control problem of maintaining postural stability during exercising needs further study in order to get a more representative perception of such an interesting biological phenomenon (Zatsiorsky, 2002). Thus, the main purpose of this study is to develop specific software that enables trainers and scientists to obtain relevant information about individual-force-exercises` biomechanics (Figure 1) (Gianikellis, Pantrigo, & Pulido, 2001). The package is mainly based in 3D Inverse Dynamics Analysis and includes special designed modules orientated to: i) Digital Signal Processing, ii) EMG analysis, and iii) Stabilometry. All the aforementioned procedures are directed to evaluate Motor Control capabilities in terms of efficiency and injury prevention of the very consistent motor patterns of the exercises in the training of force (Figure 2).

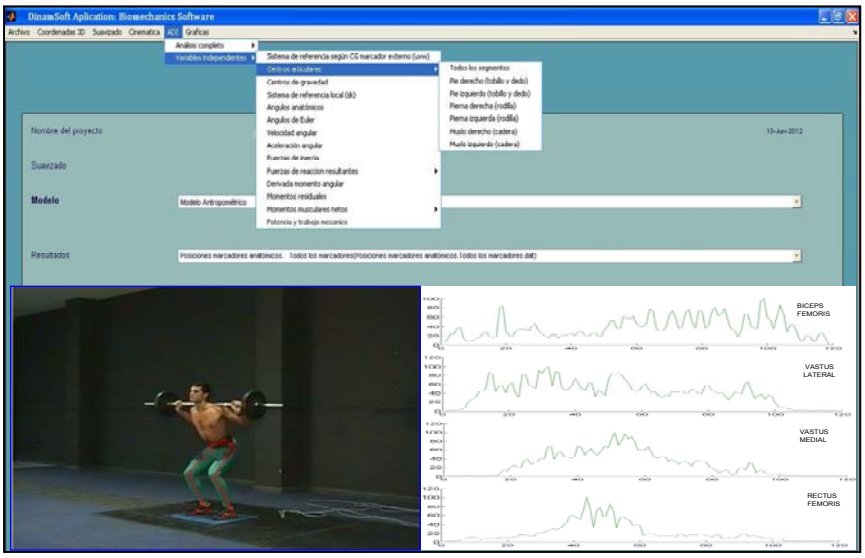

Figure 1: Main menu of *"DinaSoft 1.0".*

METHODS: The *"DinaSoft 1.0"* package was developed for the Microsoft Windows Operating System in MATLAB v. 7.10., accepting as input standard ASCII data files exported from different measurement chains and data collection systems, namely 3D video photogrammetry system (KINESCAN/IBV), two strain gauge Force Plates (DINASCAN/IBV) and EMG/ELG system. The "*Dinasoft 1.0"* flowchart includes the next (Figure 2):

i)"Smoothing" techniques for 3D kinematics. ii) Kinematics including temporal, spatial and spatio-temporal analysis. iii) Database of Inertial Parameters based on the most common anthropometric models. iv) Inverse Dynamics Analysis including Mechanical Power Analysis, v) Toolbox for Digital Signal Processing of EMG signals. vi) Stabilometric Analysis based on the Centre of Pressure displacements. vii) Graphics and animation of rigid solid models.

Dinasoft´s outputs concerning movement geometry, joints´ mechanical loads and mechanical power indicating the nature of muscular contraction (eccentric/concentric) were validated by means of the known commercial Visual3D v.4.25 (C-motion, Inc.)

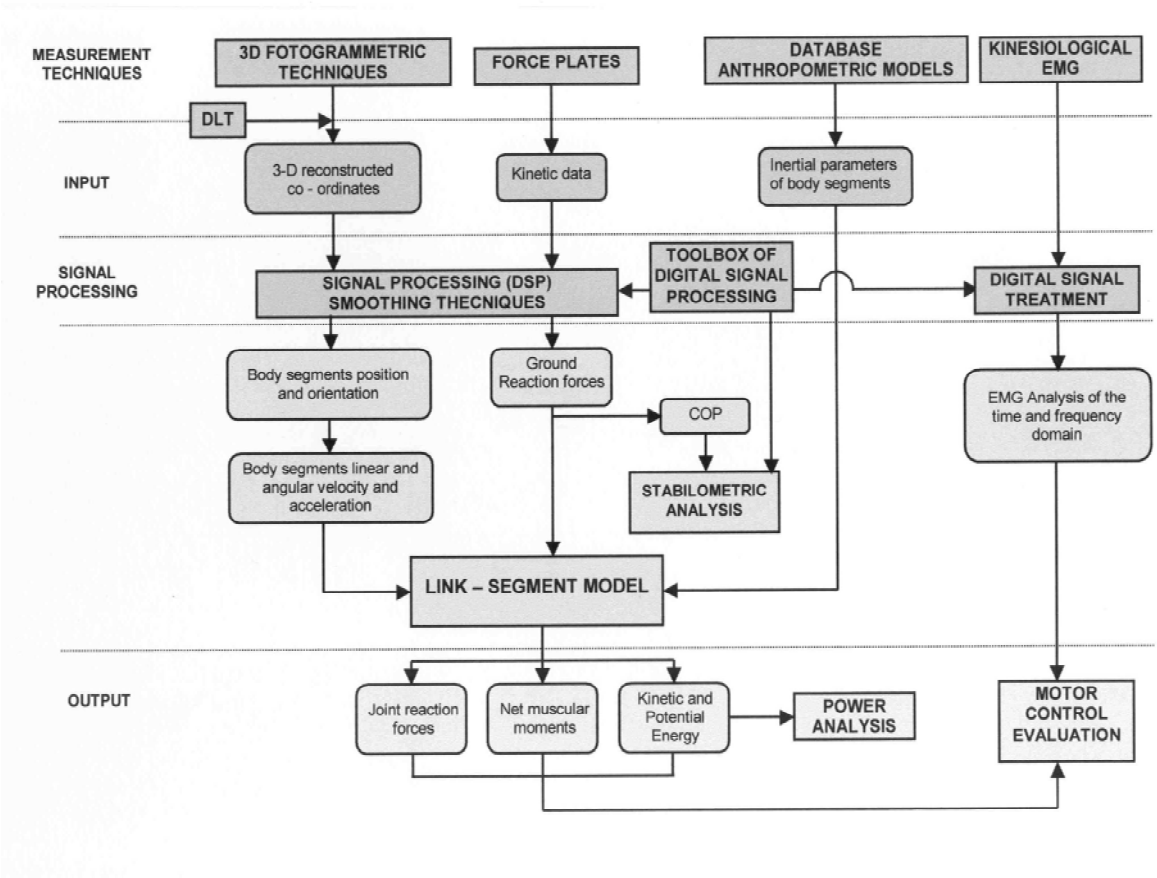

Figure 2: Flowchart of the *"DinaSoft 1.0".*

RESULTS: i) "Smoothing" and differentiation using Generalised, Cross-Validatory Splines algorithm. ii) Calculation of all linear and angular 3D kinematic parameters. iii) The user to make decisions concerning the most appropriate anthropometric model to obtain inertial parameters. iv) 3D Inverse Dynamics. v) Mechanical Power Analysis. vi) 3D simulation and animation of the movement. vii) Kinematics and Spectral analysis of the Centre of Pressure. viii) EMG analysis in the time, frequency and time-frequency domain.

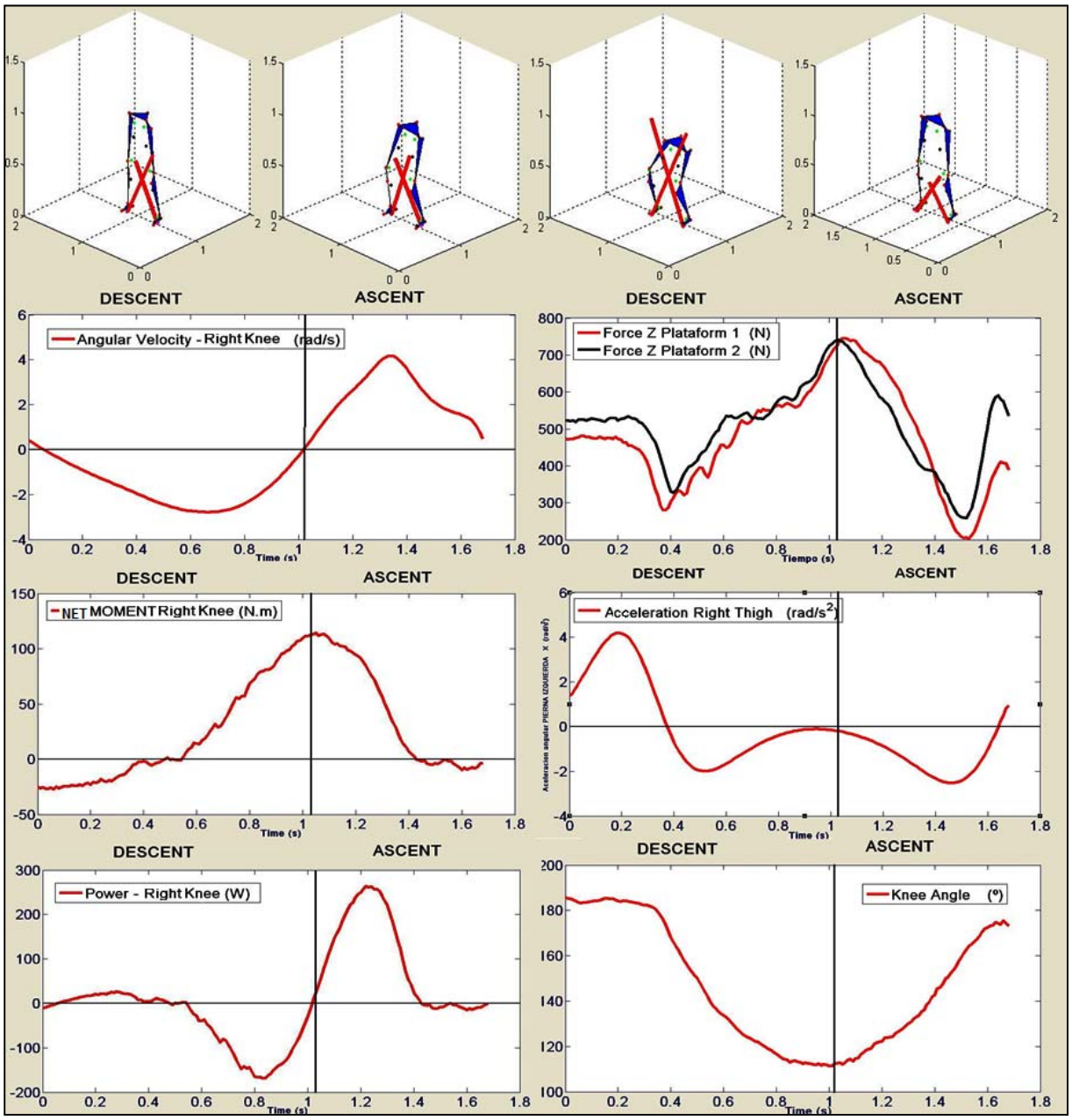

Figure 3: Graphic outputs of the *"DinaSoft 1.0".*

CONCLUSION: In conclusion, *"DinaSoft 1.0"* is a user friendly package enabling the description, analysis and evaluation of motor patterns in the force training, fitness and rehabilitation fields.

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