SENSORS FUSION FOR MODELLING AND WEAR CONTROL OF ARTIFICIAL JOINT

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Introduction

This paper presents an analytical method for predicting the velocity of tibia plateau wear when APT and IOR movements are applied to the coupling. In order to determine the kinematics of the artificial joint of balance, a bio-dimensional study was undertaken on the coupling flexion/extension movement and the antero-posterior translation. All the analyses used a model [L. Capitanu, 2008] which includes a femoral condyle and a half (medial one) of the polyethylene insert and the metallic tibial plateau. A virtual projection (VP) architecture system was designed in order to determine the occurrence of wear in high risk areas by combining the evaluation of contact mechanism and transfer of load in the articulation [G. Bergmann, 2001], integrating the 7 dynamic control loops in non-structured environments [L. Vladareanu, 2012], a Bayesian approach of simultaneous localization and mapping (SLAM) for avoiding obstacles in 3D simulated non-stationary environments and the sensors fusion method.

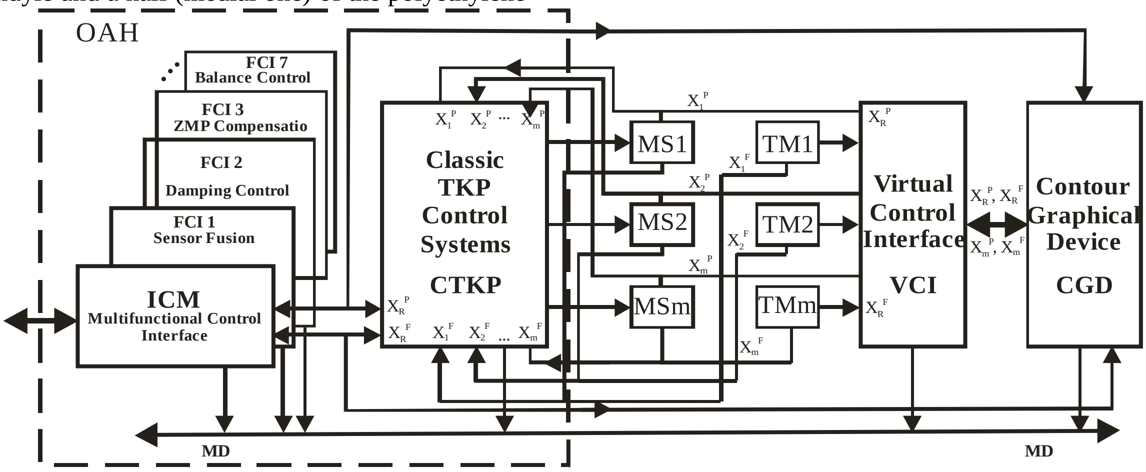

Fig.1 System Architecture for modelling and wear control of artificial joint through the VP method

Methods

The virtual projection (VP) method presented in Figure 1, tests the performance of dynamic position-force control by integrating dynamic control loops and a Bayesian interface for the 3D simulated sensor network. The CMC classical mechatronic control directly actions the MS1, MSm servomotors, where ***m*** is the number of the knee prosthesis degrees of freedom. These signals are sent to a virtual control interface (VCI), which processes them and genrates the necessary signals for graphical representation in 3D on a graphical terminal CGD. A number of ***n*** control interface functions ICF1-ICFn, as ZMP control, balance control, damping control, fusion control and others, ensure the development of an open architecture control system by intergrating ***n*** control functions in addition to those supplied by the CMC mechatronic control system. Priority control real time control and information exchange management between the ***n*** interfaces is ensured by the multifunctional control interface MCI, interconnected through a high speed data bus.

Results and Discussion

The experimental results are in good agreement with the theoretical predicted results for implementation of the total knee prosthesis simulator (TKP) by using the PC interfaces and PLCs Controller. By processing inertial information of force, torque, tilting and 3D simulated wireless sensor networks (WSN) a fusion intelligent high level algorithm is implementing. The monitored parameters are available for evaluating the prosthesis materials, implant wear, change of the friction rate, tribology behaviour, etc.

References

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