Preface

Mechatronics is an engineering field that refers to mixed systems tight integration. Currently, this integration can be viewed as based on digital computer monitoring and control, but it cannot be denied that integration can be based on any other signal processing system and any form of raw power that can be modulated and transferred to the mixed system in accordance to the output of this digital signal processor.

Distributed parameters systems, in the form of solids, liquids, gases, are seen as fields in which the dynamics can be represented by traveling waves. These fields can be mechanical vibration fields of substance, acoustic, electromagnetic etc. The assumption of continuity is often limited, when moving down from macroscopic level, by the molecular, atomic discontinuous structure, which can be represented in duality with the fields at that level. Moving up from immediate macroscopic level towards infinite celestial level, again the continuum of the quasi-vacuum space is filled with solid planets etc. Consequently, while at terrestrial macroscopic level, continuous fields can be assumed of infinite dimensions, there are perceived limits as we move up and down from this level.

Distributed Parameters Systems are modeled mathematically by partial differential equations and/or multiple integrals that can be recast also in a system of partial differential equations. The solutions of these partial differential equations show that the dynamics of distributed parameters systems can be simulated as composed of infinite dimensional combinations of harmonic components (something that might remind of Pythagoras' view of the planets motions) where higher frequency components might become less and less significant unless excited and brought to resonance.

Mechatronics refers to monitoring, control and integration not only of lumped parameters systems, but also of distributed parameters systems. In fact, the latter representation of the world under engineering focus is more realistically modeled by distributed parameters systems; handling such models is, however, much more difficult that the lumped parameters systems. Monitoring and control of distributed parameters systems is limited by ill-posed problems, the inverse problems of estimating system states and parameters from sensors signals and controlling and infinite dimensional system with modulated power output from actuators. Sensors and actuators are available in most cases as point devices and, even if they are distributed, they cannot be found in the infinite dimensional form. Sensors and actuators are bandwidth limited and cannot access higher frequency components of distributed parameters systems dynamics. As a result, only lower frequency dynamics can be controlled and maybe somewhat higher but still low frequency components can be monitored; higher frequency dynamics remains uncontrolled and unobserved. Pascal made a valid comment with regard to human condition in an infinite world: "...qu'est que l'homme dans la nature? Un néant à l'égard de l'infini, un tout à l'égard du néant, un milieu entre rien et tout." (B. Pascal, Pensées, no. 72). Using science and engineering, we reach easily documented limits in monitoring and controlling such systems and only religion, art and philosophy can offer further views outside these limits. Indeed, direct view, i.e. intuitive access to that level requires to become detached from contact and affection from the immediate and finite environment and to bring ourselves to the vision of infinite spaces.

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