

The Role of Controls in Mechatronics

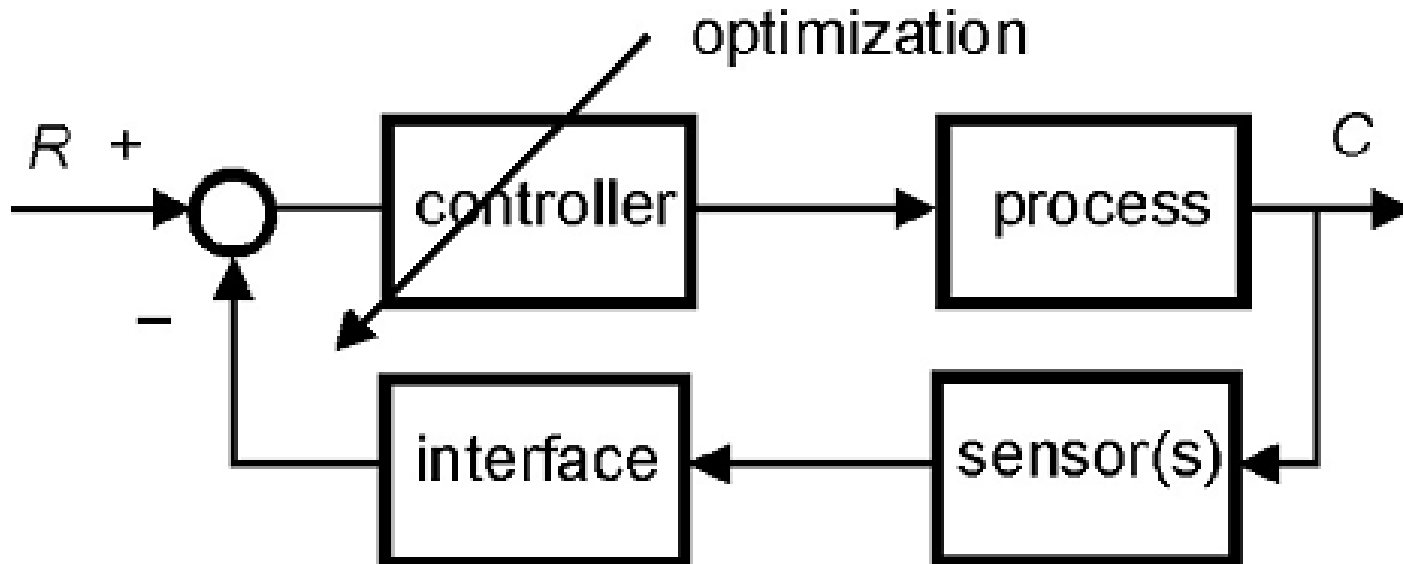
By:

Engr. Joseph Ronald Cañedo

Introduction

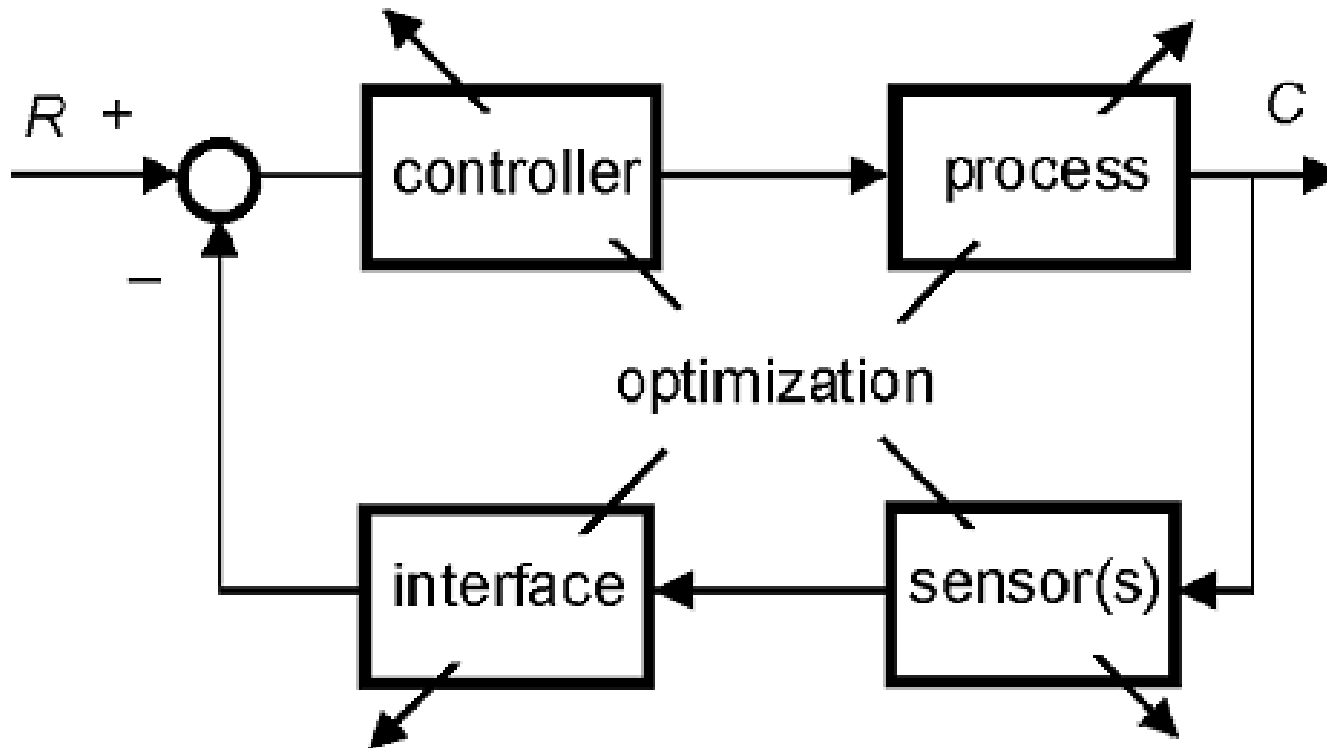
- “Mechatronic design deals with the integrated and optimal design of a mechanical system and its embedded control system.”
 - This definition implies that the mechanical system is enhanced with electronic components in order to achieve a better performance, a more flexible system, or just reduce the cost of the system.

Introduction



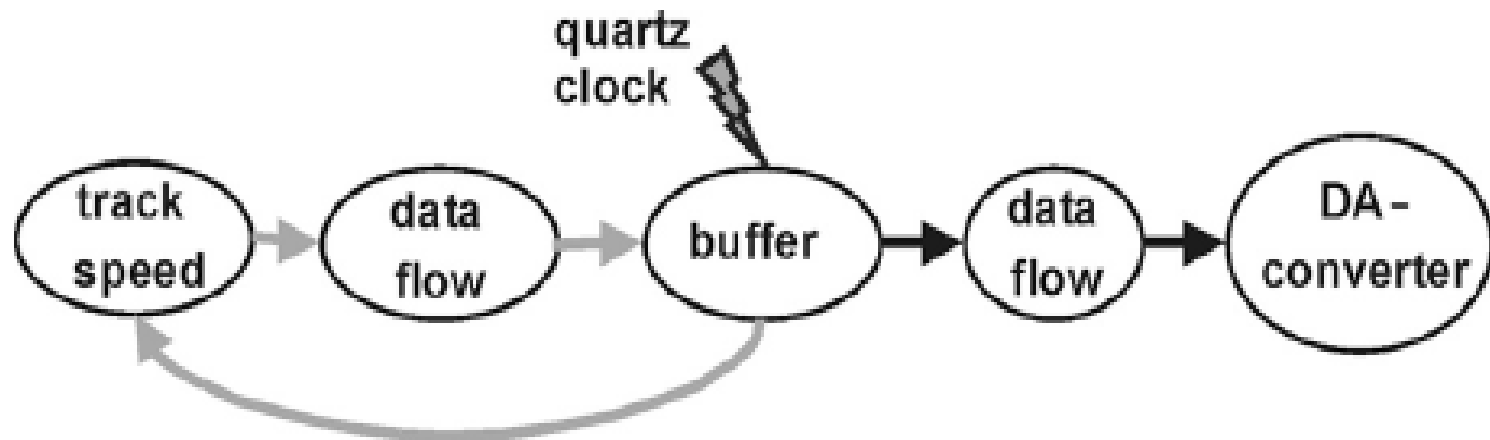
Optimization of the controller.

Introduction



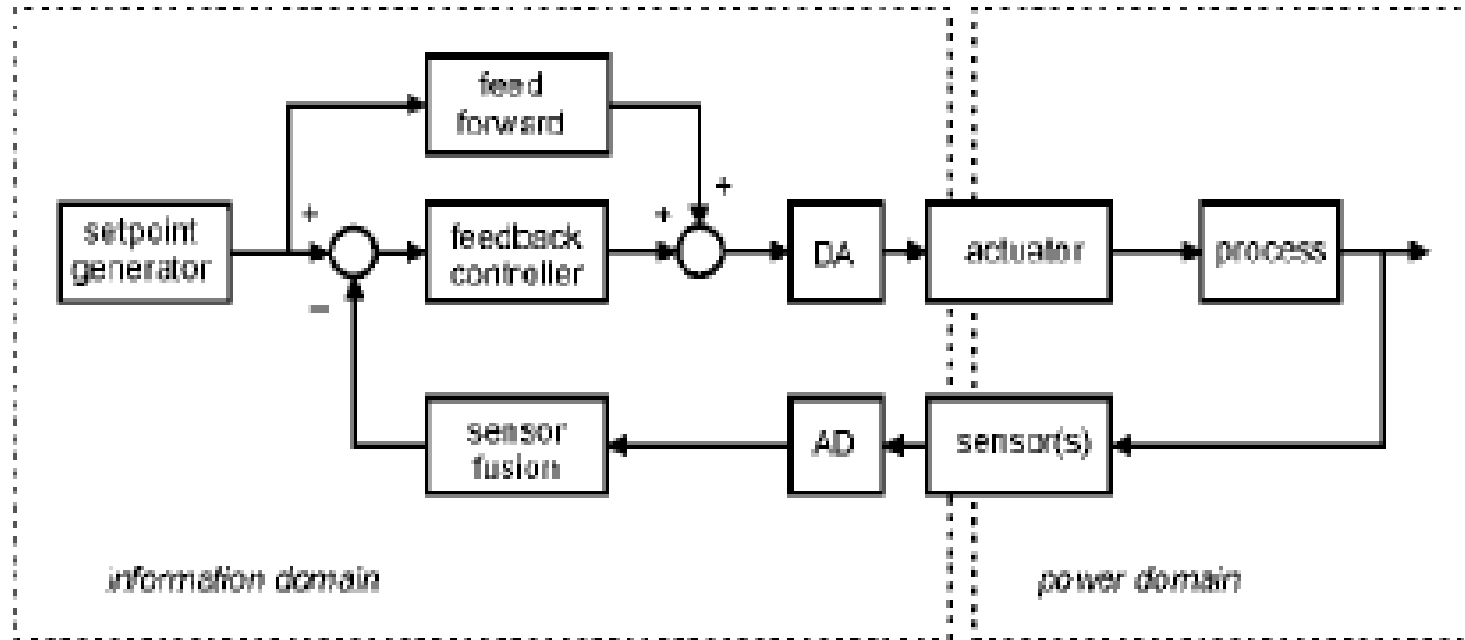
Optimization of the all system components simultaneously.

Introduction



Combination of closed-loop
and open-loop control in a CD
player.

Introduction



Mechatronic system.

Key Elements of Controlled Mechatronic Systems

- A mechatronic system consists by definition of
 - a mechanical part that has to perform certain motions and
 - an electronic part (in many cases an embedded computer system) that adds intelligence to the system.
 - In the mechanical part of the system power plays a major role.
 - This in contrast to the electronic part of the system where information processing is the main issue. Sensors convert the mechanical motions into electrical signals where only the information content is important or even into pure information in the form of numbers (if necessary, through an AD converter).
 - Power amplifiers convert signals into modulated power. In most cases the power supply is electrical, but other sources such as hydraulic and pneumatic power supplies are possible as well.
 - A controlled mechanical motion system thus typically consists of a mechanical construction, one or more actuators to generate the desired motions, and a controller that steers the actuators based on feed-forward and sensor-based feedback control

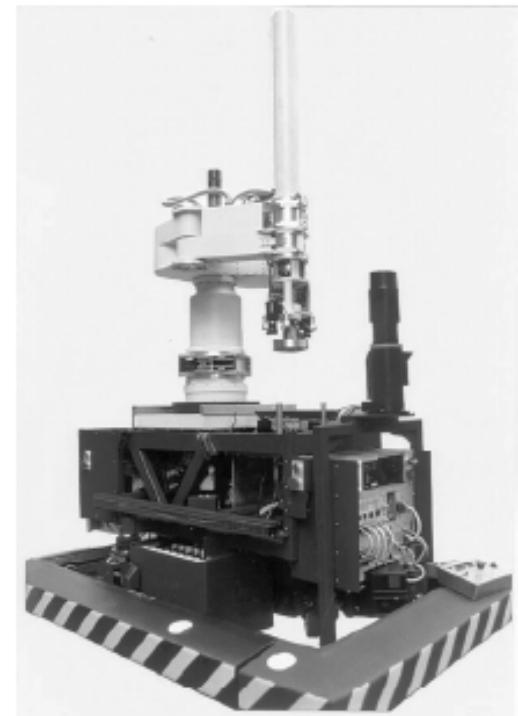
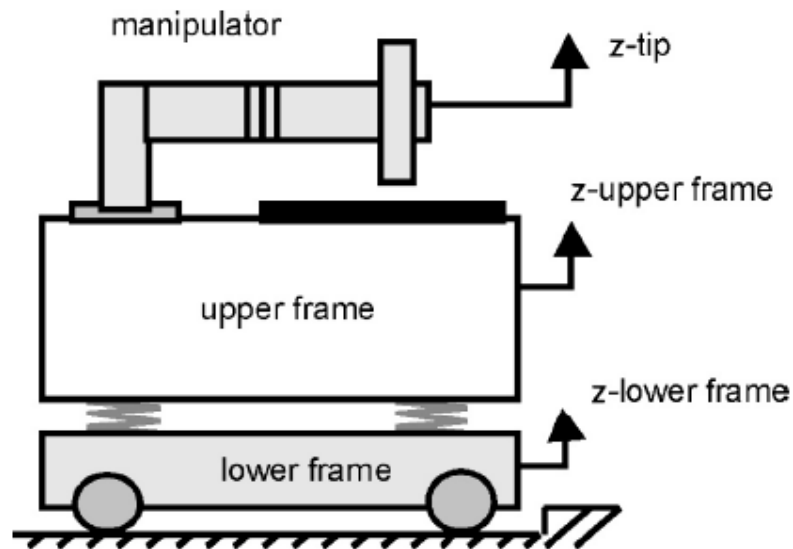
Integrated Modeling, Design, and Control Implementation

- Modeling

- During the design of mechatronic systems it is important that changes in the construction and the controller be evaluated simultaneously.
- Although a proper controller enables building a cheaper construction, a badly designed mechanical system will never be able to give a good performance by adding a sophisticated controller.
- Therefore, it is important that during an early stage of the design a proper choice can be made with respect to the mechanical properties needed to achieve a good performance of the controlled system.

Integrated Modeling, Design, and Control Implementation

- Control System Design Methodologies
 - Many processes can be reasonably well controlled by means of PID controllers.
 - Servo System Design
 - Design of a Mobile Robot



Modern Examples of Mechatronic Systems in Action

- Rudder Roll Stabilization of Ships
- Compensation of Nonlinear Effects in a Linear Motor

Term Paper!

To be submitted on
March 5, 2008

Special Requirements of Mechatronics that Differentiate from “Classic” Systems and Control Design

- The main difference between “ordinary controller design” and mechatronic system design is that the latter deals with the design of the system as a whole.
- This approach can be considered as optimization of all components of the system simultaneously, although there are no algorithms to do this automatically.

Special Requirements of Mechatronics that Differentiate from “Classic” Systems and Control Design

- In practice the problem is often split into smaller problems that can be optimized. After integration of all the partial solutions a suboptimal system is achieved that can be further optimized by retuning the different parts, taking into account the already available intermediate design of the overall system.
- In order to achieve optimization of the system as a whole, it is desired that the mechanical part, where power plays a role, and the information processing part (the controller) can be simulated and adjusted simultaneously.
- This requires that mechanical parameters like masses and compliances be available in simulations of the controlled system.

