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## CONTROL SYSTEMS ARE UBIQUITOUS

Control systems are ubiquitous, essential, and largely invisible to the general public. Products ranging from the paper that we use, the beer, wine, or water that we drink, the newspapers that we read, to the drugs that treat our diseases depend on automatic controllers for their uniformity and consistency. A typical example regulates the thickness of aluminum sheets.

Our homes are full of automatic control systems. There are thermostats to regulate the temperature of the house, the refrigerator, the dishwasher, the clothes washer and dryer, the oven, and the hot water heater. The level of water in the toilet tanks and the sump pump is also automatically controlled. Many household controllers are less obvious. These include the automatic controllers that regulate the flow of fuel to the furnace, those inside the TV, radio, CD and DVD players and any other electronic devices in the house and those that insure that our coffee maker and microwave oven work properly.

The modern automobile is full of automatic controllers. Pollution is reduced, fuel is saved, and comfort is enhanced by automatic controllers in the car. Stability and control augmentation systems (SCAS) make nearly every modern vehicle easier for the human to control and safer. These systems work with the human operator to make him or her perform better. An excellent example is **ABS brakes**, one of the SCAS subsystems. Another excellent example of a SCAS is the basis for **Robotic surgery**. Still another example of a SCAS is the control system in the X-29 experimental aircraft.

The X-29 was designed to be unstable. Without its control system (SCAS) it was unflyable. It would disintegrate within seconds. Difficulties in designing its controller led to important research and new knowledge on the limits of control systems.



NASA Dryden Flight Research Center Photo Collection  
<http://www.dfrc.nasa.gov/gallery/photo/index.html>  
 NASA Photo: EC91-491-6 Date: September 13, 1991

X-29 at High Angle of Attack

The members of the animal kingdom are also full of automatic controllers. The temperature of our body, the movements of our limbs, our heart rate and blood pressure, the amount of glucose in our blood, and our weight are all regulated by feedback controllers within our bodies. There are serious diseases that result from improper operation of these controllers. Automatically controlled insulin pumps and more and more sophisticated controlled prostheses are helping to mitigate these problems.

Improvements in many aspects of our lives will depend on improved control systems. For

example, better control system would greatly reduce the non uniformity in temperature that is so annoying in many office buildings and homes. It has already been demonstrated that autonomous vehicles can safely navigate a complicated closed course. Improvements in the control of automobiles could eliminate the need for a human driver and greatly enhance the safety of automobile travel. Safer cars could be made much lighter, thereby reducing the amount of energy they need to function.

This has been a very brief overview of the role control systems do play and might eventually play in allowing us to live better. There are many more examples of control systems that are working today. And, there are innumerable opportunities to improve control systems in the future. The IEEE Control Systems Society exists to facilitate these advances.

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