4. Automation and Control Systems

Systems and Control

Systems and Control is a paradoxical area.

On the one hand it is a branch of Engineering Science which is applied to almost any area of human endeavour – if it moves then it almost certainly could not do so without a control system; on the other hand it is almost always invisible only coming to attention when systems fail.

In Engineering, the emphasis is on physical systems but the methodology is widely applied elsewhere, for instance in macroeconomics, finance and actuarial studies.

While it has a core concerned with the development of basic theory and algorithms and design, systems and control is fundamentally a cross-disciplinary activity with applications drawn from any discipline where dynamic systems are relevant.

Although individual academics set their own research agendas, a number of themes may be discerned in the research activities in Electrical Engineering and Telecommunications. This work includes collaborative activity with a range of colleagues both domestic and international.

For more details, please visit our website:

http://www.engineering.unsw.edu.au/electrical-engineering/systems-and-control

Robotics and Autonomous Systems

In Robotics and Autonomous Systems, we research and develop methodologies to be used in achieving persistent autonomous operation of aerial and ground vehicles. In aerial vehicles, our innovative vehicle design is complemented by the development of advanced flight control systems to achieve highly precise and stable flight platform operations. In ground vehicle systems, we develop 3D perception methodologies that can deliver highly accurate vehicle localisation. This is complemented by control systems that deliver accurate spatial navigation at high operational speeds in disturbance ridden outdoor terrains.

Autonomous Urban Transportation Systems: We develop public transport load models and schedule a fleet of autonomous buses using dedicated public transport road networks such as Sydney's T-ways. The optimized vehicle and load management system takes into account both operational costs and customer satisfaction. The current simulation models employ the full dynamic models used by current public transport bus systems. The models also implement specially developed path tracking and vehicle following algorithms to guide the autonomous buses along planned routes. The proposed methodologies drastically reduce the infrastructure costs by eliminating the need for items such as road signs, lane marking and traffic lights in dedicated transit roads.

Agricultural Robotics: We develop advanced vehicle systems and the guidance systems required to navigate large scale agricultural machines with very high accuracy and high speeds. The aim is to go far beyond current autonomous navigational capabilities by achieving individual plant level accuracy in managing thousands of hectares of land. We use centimetre level navigational accuracy in advanced vehicle guidance systems to apply substances such as fertilizer and herbicides exactly where they are needed, thereby drastically reducing wastage and cost of broad acre farming, while significantly improving effectiveness and sustainability.

Perception: We use inexpensive sensor modalities and develop methodologies for the fusion of advanced sensor data to accurately map the surroundings of field vehicles. The aim is to rely on the most basic of sensors to obtain a reliable and accurate picture of the surroundings. Through unsynchronized acquisition of sensor data at multiple rates, combined with the use of data fusion algorithms, we achieve real-time perception at multiple nodes of a distributed system of vehicle and geographically stationary processing nodes.

Force Controlled Vehicles: We develop new vehicles that are controlled using forces applied at the wheels rather than velocities applied at the wheels. The aim is to determine the optimum set of forces that need to be applied to the vehicle to make it follow a path or trajectory with exceedingly high spatial precision and speed. The vehicle is equipped with force sensors at each of the wheels. It has been found that this arrangement leads to the uncoupling of force controllers at each wheel, thus enhancing the accuracy of the force controller.

Flight Control Systems: We research the behaviour of vectored thrust aerial vehicle through dynamic modelling and simulation and develop flight control systems to stabilize such platforms. These control systems are then applied and tested with our experimental vectored thrust aerial vehicles.

Robotics and Autonomous Systems Laboratories:

- Mechatronics Lab

For more details, please visit our website:

http://www.engineering.unsw.edu.au/mechanical-engineering/robotics-and-autonomous-systems