One of the three nodes of the ARC Centre of Excellence for Autonomous Systems – Funded from 2003 – 2010.

**Team**: 53 robotics researchers (starting from 1 in 2002)
- 9 Academic staff; 9 Postdocs; 4 Research Engineers
- 28 HDRs (10 or 35% are UTS graduates)

$14M in external research funding since 2003 ($1.7M in 2014)

**Teaching**: Mechatronics Undergraduate Program: 300+ students in total

One of the leading robotics research teams in Australia
UTS:CAS

- Reputation: (1) World leader in SLAM: most cited robotics paper since 1996; (2) International leader in infrastructure maintenance robotics; (3) Australian leader in assistive robotics

- **Research strengths**: sensing, mapping, motion planning, human-robot interaction → Robots in complex, unstructured environments and working with people

- **Application** of robotics in infrastructure, mining, stevedoring, agriculture and manufacturing

- Track record for delivering industry outcomes

- Entrepreneurial culture
CAS: FUNDAMENTAL RESEARCH

(1) Robots in unknown and complex environments
   - Sensing, mapping, motion planning, exploration and perception
   - Simultaneous localization and mapping (SLAM): “Finding your way in a city without GPS and maps”

(2) Human interactive robotics
   - “Human models” and control;
   - Robotic co-workers

(3) Robot Teams in Dynamic Environments
   - Coordination and Control
   - Simultaneously scheduling and planning
CAS: ENGAGEMENT

Autonomous robots for industry automation:

- Bridge rehabilitation
- Underground mining
- Water mains condition assessment
- Logistics and transport

Assistive robots:

- Robotic co-worker for manufacturing
- Healthcare and aged care
- Meat and livestock industry
- International competitions: RoboCup search and rescue, Robot@home, Amazon picking challenge, DARPA)
AUTONOMOUS INDUSTRIAL ROBOTS

Robotic Systems for Steel Bridge Maintenance

- Worker safety and productivity
- Autonomous robots operating in complex and dusty 3D environments
- Two robots operating in the SHB
- SABRE: An Australian start-up
Platform Design
- Ultra lightweight
- Quick and easy setup
- Minimal manual handling

Nozzle/Sensor Fittings
Automated calibration
Safety control system
Intuitive User interface
Heavy-duty Protection
MULTI ROBOT COOPERATION

Two blasting robot collaboration and collision avoidance
BIOLOGICALLY INSPIRED AUTONOMOUS CLIMBING ROBOTS

Major challenges:

• Areas that are difficult to access
• Negotiation with rivets
• Inverted walking
• Positive and negative corners openwork truss structures
• Robot design
• Two prototype climbing robots have been designed and tested in the Sydney Harbour Bridge (SHB);
• A robot is going to be delivered to the SHB by April 2015
ROBOT TEAMS - LOGISTICS

- Coordination of robot teams
- Applied in the world’s first fully automated container terminal;
- Potential applications: material handling in warehouse, airport; manufacturing plant, etc
- Significantly improve the productivity
UNDERWATER MAINTENANCE

- Develop an underwater robot for cleaning and inspection
- Address the research issues and develop enabling methods
ASSISTIVE ROBOTICS

Research Challenges:

• Building robots that cooperate with people is harder than building a fully autonomous robot
• Perception and Navigation in Dynamic Environments
• Human Intention Recognition
• Manipulation of Natural Objects
• Safe Physical Interaction

Application Domains:

• Robotics for Ageing in Place
• Robotics for patient care
• Manufacturing: robotic co-worker
ASSISTIVE ROBOTICS: CO-WORKER

- Assistant-As-Needed paradigm
- Reduce forces while performing manual tasks
- Safety framework
- Intelligent control through the integration of musculoskeletal, task and robot models
- Robot development
ASSISTIVE ROBOTICS: CO-WORKER

- Safe physical human-robot interaction
- Intuitive interaction;
- User intention recognition
- Situation awareness and collision avoidance
EDTAS – TRENDS, BARRIERS, DRIVERS

Technical/Social Trends:
- Collaboration (Multi-Robot; Human-Robot)
- Assistance As Needed (Intent)
- Deep Learning (Demonstration / Interaction)

Barriers:
- Technology: Perception (Sensing)
- Complex Reasoning in Dynamic Environments
- Trust / Legislative

Drivers:
- Aging Population, Labour / Skills Shortage
- Private Venture Capital: SpaceX, Google, Uber
AUTONOMY - EVOLUTION

< 5 years:
Complete Logistics Automation

< 20 years:
Driverless Vehicles in Non-Urban Point->Point (under constraints)
Automation of tasks without complex reasoning (Human on Loop)
THANKS!