Knowledge Utilisation
Technology, Process and Simulation
Centre for Intelligent Systems Research

• We aim to discover and deliver innovative research that directly benefits society through the creation of knowledge and provision of solutions to real world problems

• A team of 60 researchers, including:
  – research academics and post docs
  – post graduate research students
  – dedicated software and database technicians
  – mechanical workshop technicians

• State-of-the-art simulation, visualisation, robotics and haptics facilities
Centre for Intelligent Systems Research

• We develop algorithms, methods and tools to improve estimation and performance of complex systems operating under uncertainty, variability and continuous change

• This is complemented by research on next generation robotic control systems and force emulation methodologies to improve process reliability, product quality and operator safety in complex environments

• We are active in project domains including manufacturing, airports, defence, mining, warehousing, security and logistics
Data Capture Technologies
Haptic Interfaces allow users to touch virtual models and remote objects
Haptically-Enabled Optometry Simulation

- Interactive collision detection and force rendering
- Complex and immersive physical property definitions
- Integrated into real optometry slit lamp equipment for training
- Augmented reality enabled
Virtual Simulated Work Environments
to design manual processes and train operators
Haptically Enabled Art Realisation project to allow the blind to experience art through touch
Gaming Controllers – Kinect Device

- Very affordable and suitable for low budget projects
- Perfect for small environments
- Can operate in many lighting conditions
- Structured light technology
- Projects an infrared pattern and measures the distortion
- Tracks marker-less skeletons in both 2D and 3D
- Limited resolution

http://www.deakin.edu.au/cisr
3D Biometrics using MS Kinect Device

Kinect devices → Collect images → Calibration algorithm → Calibrated point clouds → 3D Meshing algorithm → 3D mesh → 3D Facial features detection algorithm

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Use of Desktop Motion Capture to Interact with Computer-based Training Systems
Leap Motion – High fidelity hand motion tracking
Mixed Reality environments that combine real worlds and virtual worlds
Immersive Simulation for Training
Geelong Port

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Motion Capture and Artificial Intelligence in Dance Technology
Haptics, HMI and Simulation-based Training
Universal Motion Motion Simulator

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Process Modelling and Analysis

Research platform domains

- Logistics and Supply Chain
- Energy Systems
- Mining and Materials Handling
- Airport Security Systems
- Warehousing and Air Cargo
- Manufacturing Facilities

Characterisation
Simulation and Modelling
Optimisation
Decision Support, Training and Control

Abstraction, reduction and generalisation of engineered systems
Data driven estimation and forecasting
Robust optimisation, routing, sequencing and scheduling
Visualisation for decision making and training in complex environments

Event-based simulation modelling

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Types of Business Simulation

System dynamic (SD) simulation

Agent-based simulation (ABS)

Discrete event simulation (DES)
Manufacturing and Logistics Supply Chain Modelling

- Discrete event simulation is used to model process variability and uncertainty
- Design, planning and operation of Futuris greenfields Just-in-Time facility
- Custom schedule gave better performance than customer (Ford) sequence by 22%
- Operators numbers optimised
- Process bottlenecks identified

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Air cargo supply chain studies for Office of Transport Security to determine financial impact and supply chain risk of selected security policies

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Visual simulation supports knowledge elicitation and utilisation, and helps overcome many challenges associate with process improvement in complex adaptive systems.
Human factors are critical in the application of model driven methods of knowledge elicitation and application
Warehouse & Distribution Centre Modelling

- Capacity, travel time, inventory and resource estimation
- Warehouse management system emulation
- Routing and flow modelling
- Power & free conveyor controller rules
- Layer picking algorithms
Air cargo supply chain studies for Office of Transport Security to determine financial impact and risk of selected security policies

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Advanced agent-based algorithms to model passenger movements through moving bottlenecks
Image processing algorithms and video analysis tools methods
Data collection tools to capture spatial, frequency and timing information using mobile devices
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Data Cleaning Tools
Analysis of Inter-event Times

Time Between Events vs Time

- Commence Level 1 to Level 1 Pass

Analysis Type
- TBE
- TBE.Last
- TBE.Via
- TBE.Next
- InterArrival.Time
- Raw
- Compound
- In.Sys.Count
- In.Sys.Count.TBE
- TBE.In.Sys.Count_filtered
- Throughput

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Automated Reporting of Simulation Results using Event Profiling
Low Cost Data Collection and Analysis for Improved Quality Outcomes

Automotive Stamping Processes

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Quality Tracking System Platform

- CISR have developed a knowledge capture and quality tracking system in collaboration with the Geelong Quality Council.
- Trials have resulted in a 20% reduction in part defects for Geelong Manufacturers.
What-if Analysis to Support Decision Making

Ford Iron Casting Plant

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Fitness Landscapes - Robust Optimisation

Robust

Optimal

Metal (Tonnes per hour)

Charge Car Capacity

Ladle Capacity
Prediction and Image Processing to Visualise Quality
Real time simulation framework to capture and utilise expert knowledge to plan, schedule, and optimise logistics systems and perform risk analysis
Dashboard Visualisation of Simulation Results

Weekly Summary

Tonnes Produced

Tonnes Railed

Daily Production by Product Type

Daily Railed by Product Type

Stockpile Inventory

Production Cumulative

Railed Cumulative

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