The Journey of building ROS-Industrial initiatives in Asia Pacific

ROS-Industrial Consortium
Asia Pacific

Present by: Nicholas Yeo

14th Sep 2018

- Who we are
- ROS-Industrial Consortium
- Today challenges
- What we are trying to achieve

Who are we?

ROS industrial consortium asia pacific

Advanced Remanufacturing and Technology Centre (ARTC) under Agency for Science, Technology and Research (A*STAR)

- Focused in Advanced Manufacturing and Remanufacturing technologies
- Bridge the gap between Research and Industry
- Private Public Partnership Consortium with a membership ecosystem

Smart Manufacturing

- Test-bedding of Industrie 4.0 Technologies

Advanced Robotic Applications

- Develop niche robotic application for manufacturing

Advanced Remanufacturing

- Regenerative Repair Processes

Additive Manufacturing Industrialisation

- Focus metal printing for production use

Intelligent Product Verification

- Metrology, Inspection, condition monitoring technologies

Data-Driven Surface Enhancement

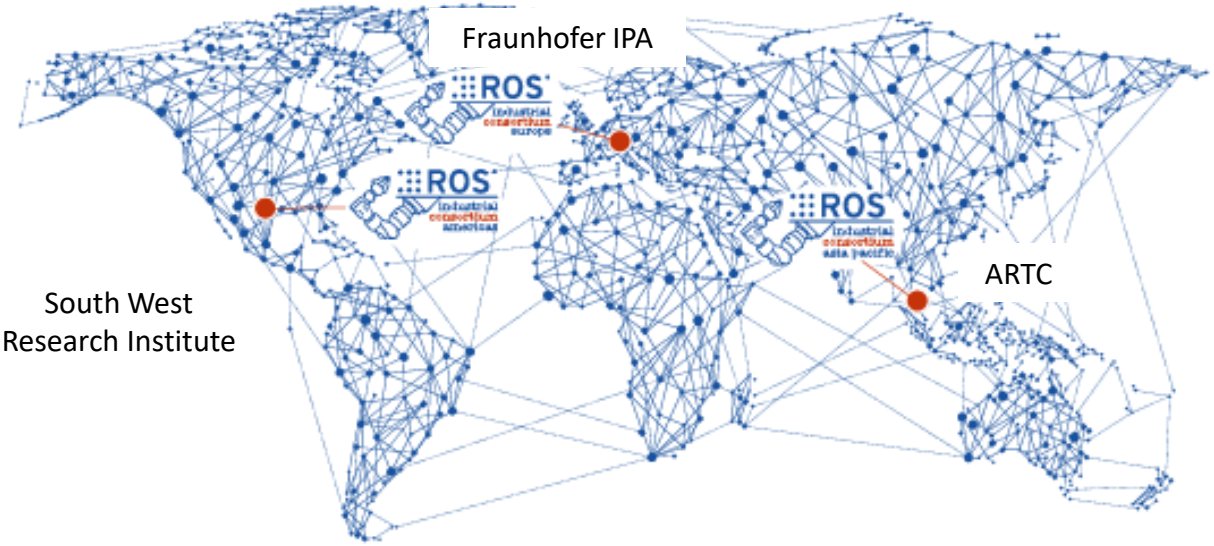
- Fatigue life improvement

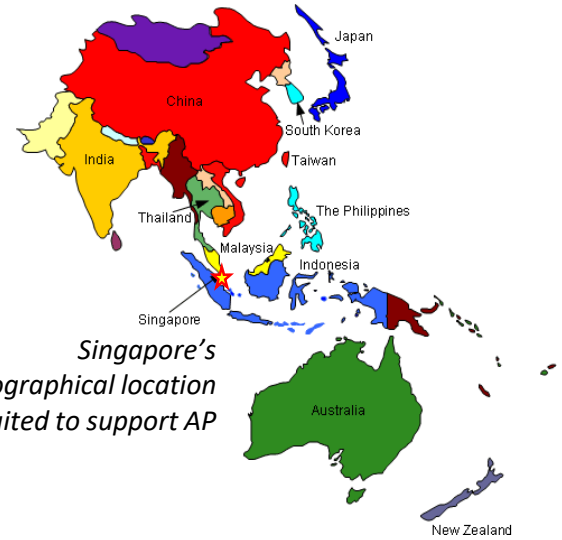
ROS-Industrial Consortium

ROS-Industrial is an open-source project that extends the advanced capabilities of ROS software to manufacturing.

Asia Pacific's Objective:

- Increase global competitiveness of the robotics industry through ROS development and adoption in Asia Pacific
- Develop ROS-Industrial talent pool through training, summer schools and workshops
- Address specific features for industry applications





Singapore's geographical location suited to support AP

This runs separately from ARTC's consortium. Projects run by ROS-I APAC Consortium will be managed by ROS-I Consortium structure and guidelines in the ROS-I APAC membership agreement.

ROS-Industrial Consortium Members > 60

ROS industrial consortium asia pacific

Source: http://rosindustrial.org/ (dated Jul 2018)

AP Members since Oct 2017

ROS industrial consortium asia pacific

ADLINK

TONY ROBOTICS

PEPPERL+FUCHS

M8M

BLUE OCEAN ROBOTICS - for humans

UNITECH

woodside

Tokyo Opensource Robotics Kyokai

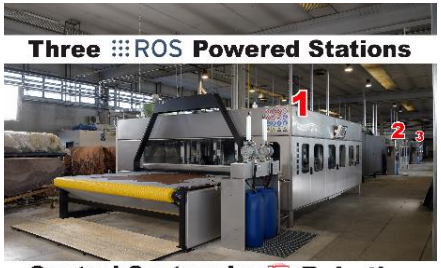
REPUBLIC POLYTECHNIC

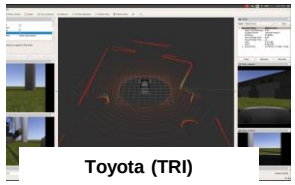
NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

And growing.....

Industry adoption of ROS

ROS industrial consortium asia pacific



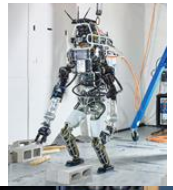


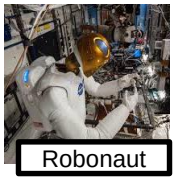
Manufacturing

Logistic

Agriculture

Automotive





Military

Disaster Mgt

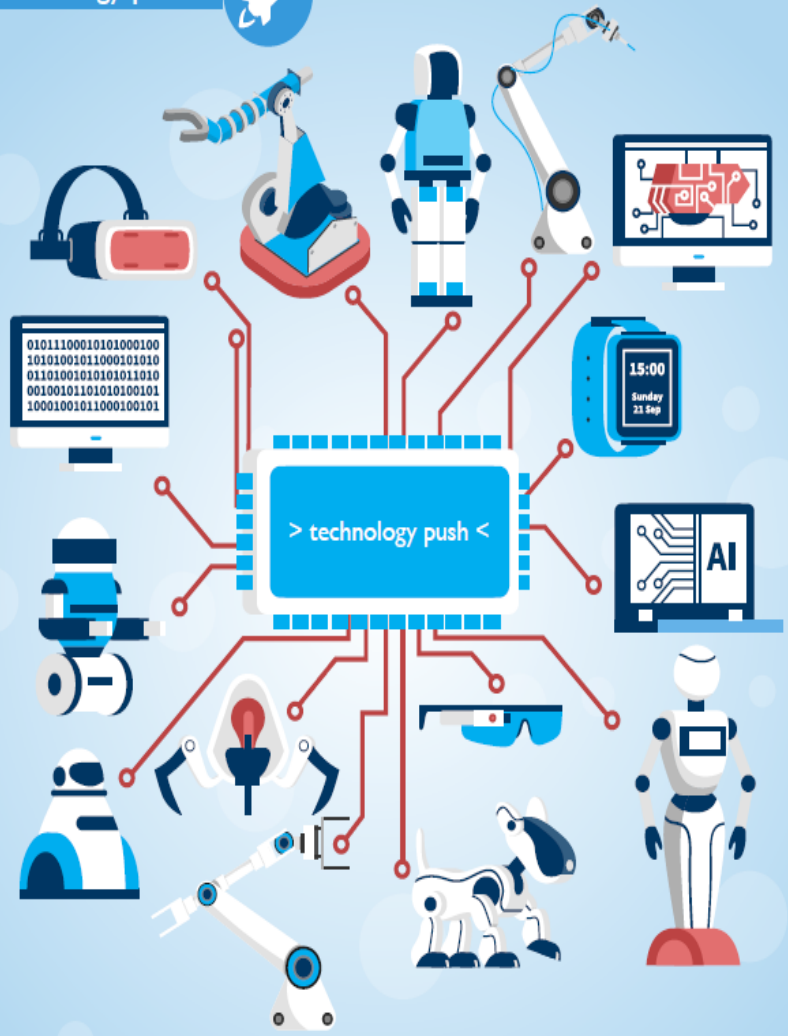
Aerospace

Space

Construction

Why did it start?

> technology push <



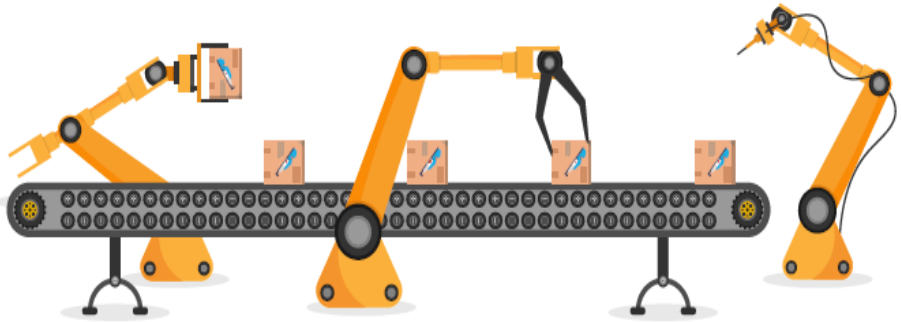
"Robotics science" is rapidly maturing robots every day at lower costs:

- New collaborative robot arms, 10k EUR
- Sensors for high-volume markets
- Smartphones, IoT, gaming devices, high performance computing in small packages
- Mobile and intuitive interfaces

> market pull <

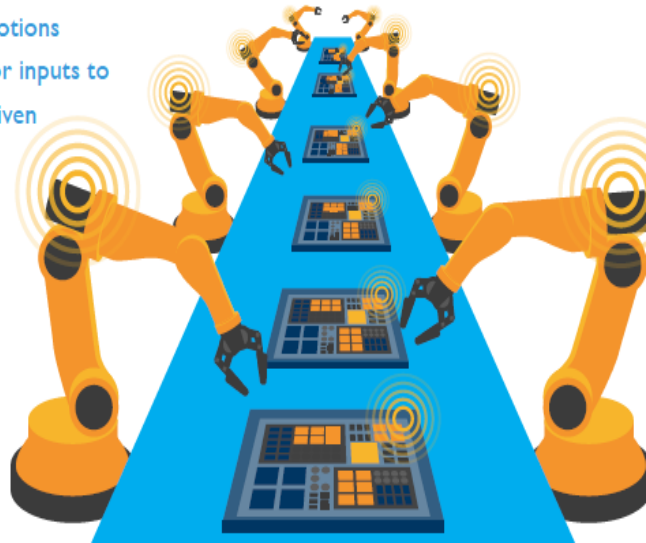
- Mass customization: Industry 4.0, low-volume high-mix production ("lots of size 1")
- Expansion of robotics and automation in logistics; new markets (e.g., service robotics)

-> need for advanced, adaptable, and flexible automation



"Smart skills" + modern hardware -> automation technology meeting demands

From preprogrammed motions triggered by simple sensor inputs to on-the-fly trajectories driven by a perception-rich environment



Source: SwRI ROS-Industrial Brochure

Today Challenges thru PEST Analysis

Political Factors	Economic Factors	Social Factors	Technological Factors
P	E	S	T
• Government Support on collaboration & adoption (Private / Public) • Legislation	• Business ROI • Economy of Scale • Fragmented supply chain • **IP & Legal Challenges** • R&D Funding Limitation in private entities	• **Scarcity of talent pool** • Retraining of workforce • Awareness of open source • **Less successful cases of robotic solutions adopted in Asia**	• **Technology maturity** (eg: reliable performance, cybersecurity, supporting hardware) • **Quality of sw codes** • **Standardization** (eg: HRC, safety, interoperability) • Regulatory

Key challenges with industry adoption

- In robotics, the success depends on the entire system; not individual performance of modules
  - Robot solutions are often unique; existing complexity and issues make it difficult for companies to learn and figure it out
- In industry environment, companies want guarantee in performance (eg: Security, real-time) and certified to safety standards (eg: ISO/TS 15066)
- Skeptical on open source codes due to business risks and intellectual property liability

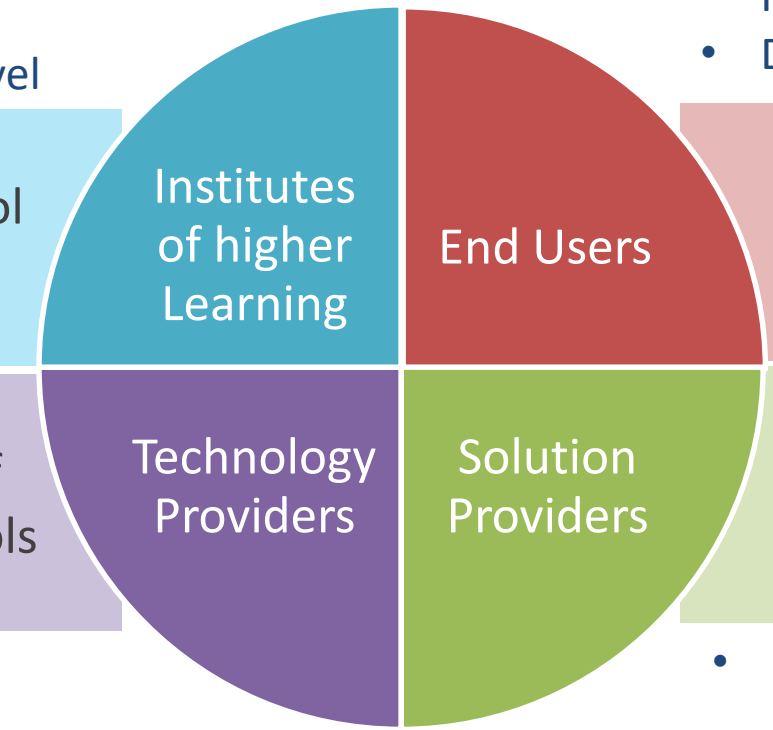
We need to win the **trust** of industry

Engaging the ROS-Industrial Ecosystem

ROS-Industrial AP Strategy

- Developers Training (Basic / Advance Class)
- Summer Schools
- Future: Application level

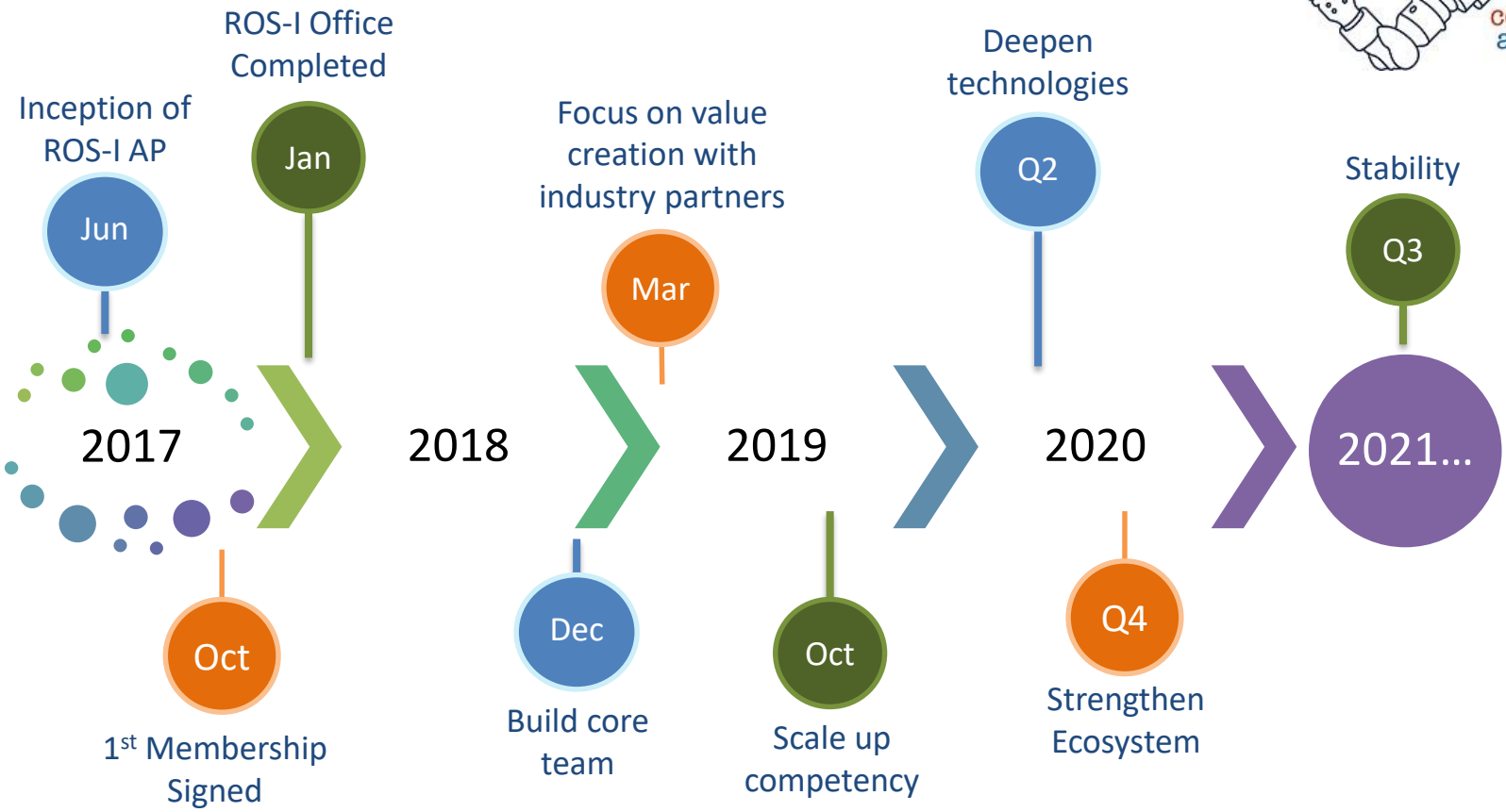
- Roadmapping
- Focus Technical Projects
- Direct Projects



- Code maintenances & updates
- Conduct Hackathons

- Same as above

Holistic view of our journey



Phases			
Start-up	Ramp up	Expand	Stable

Talent Development

ROS Developer Training

- Conduct quarterly (Basic / Advanced packages)
- 6 training since Jun 2017
- > 60 participants trained

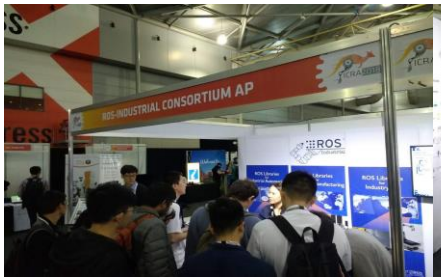
Summer School

- Conduct annually with a local school
- Mar 2018 collaborated with Singapore Polytechnic
- Focus on student awareness
- ~ 20 students

Events – Promote ROS awareness

International Conference on Robotics and Automation (ICRA) 2018– Brisbane Australia

Singapore International Robotic Event (SIRE) 2017



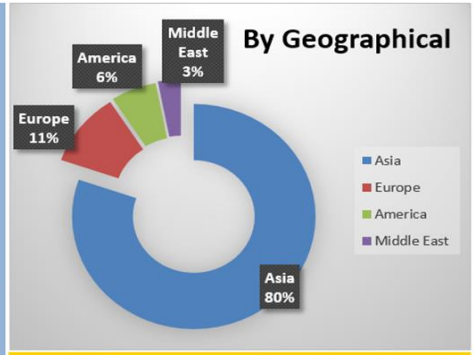
Annual Workshop – Jun 2018

27th – 28th June 2018
2 Days of presentations (International, Regional and Local)
Demonstrations and Exhibition

66 > participants

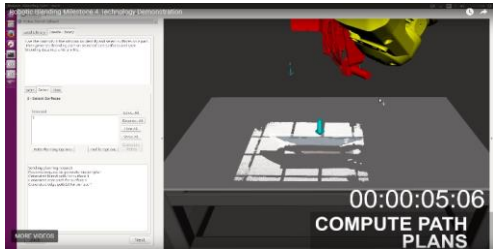
Over 20 Countries

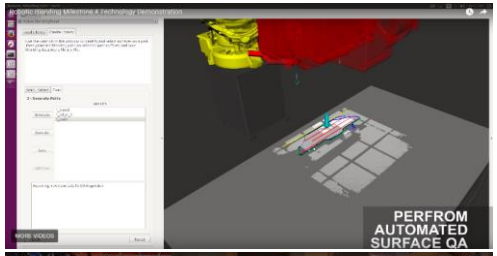
Singapore
China
Malaysia
Taiwan
Japan
India
United States
Philippines
Italy
United Kingdom Colombia
Sweden
South Korea
Lebanon
Iran (Islamic Republic Of)
Indonesia
Canada
Vietnam
Netherlands
Norway

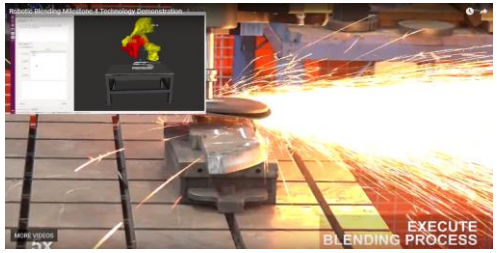


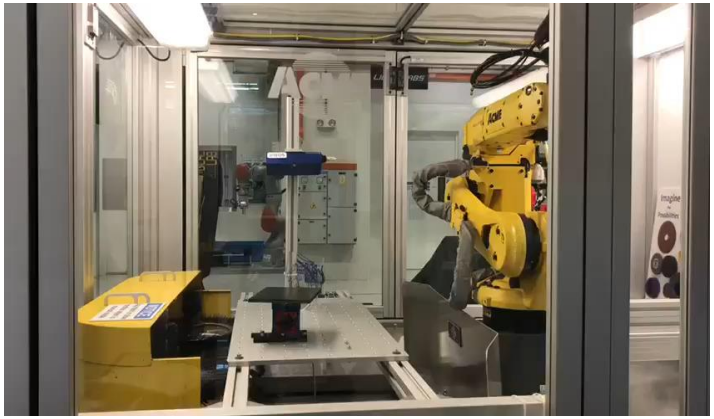
ROS-INDUSTRIAL PROJECTS EXAMPLES

Scan-N-Plan™ in Singapore







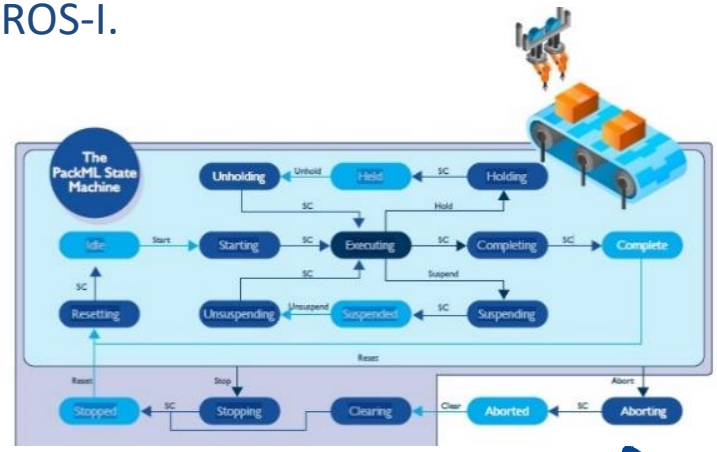


ROS-I added capability for:

- Universal Robotics
- Fanuc

PackML: Scope & Deliverables

- **Collaborators:** 3M, ARTC, SwRI, PlusOne Robotics
- **Problem Statement:** Software development of using PackML state machine to communicate between PLC and ROS.
- **Delivered:**
  - **Tested** with a **remote PLC** using a standard PackML implementation **using OPC-UA** to connect to the PLC
  - **Developed** an open-source C++ library, python (SMACH) to **implement the PackML state machine** abstraction for use in ROS-I.
  - **Integrate RVIZ** plugin for PackML
    - PACKML State Machine
    - Provide options for mode selection
    - Show accumulative timer per state



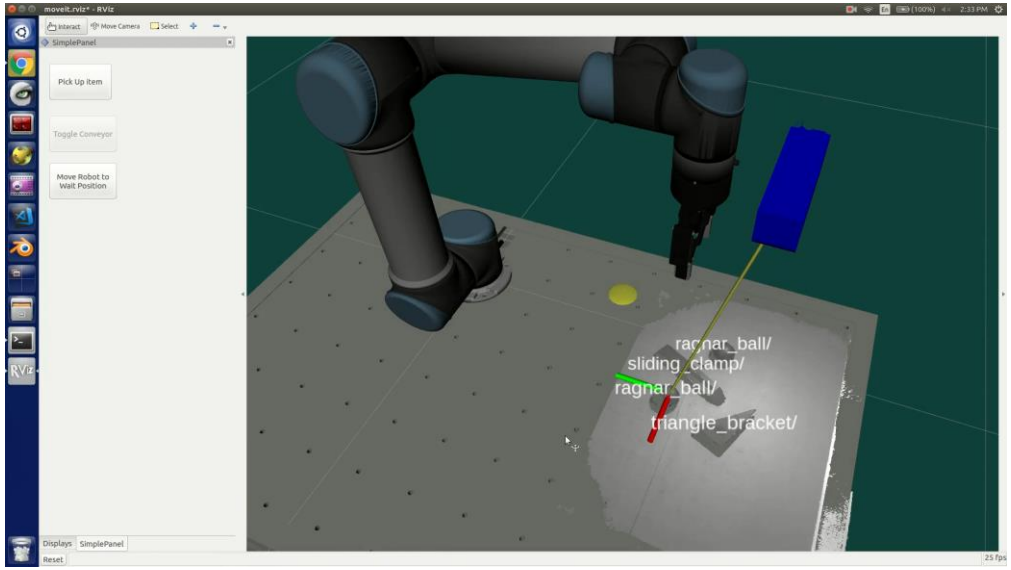
PackML (Packing Machine Language) state machine commonly used by PLCs in packaging

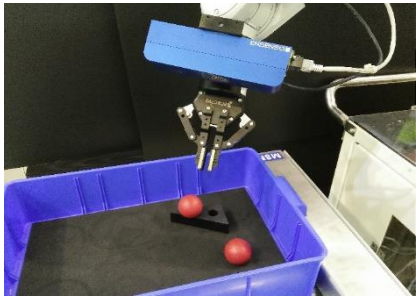
Robotic Vision: Object recognition and picking task

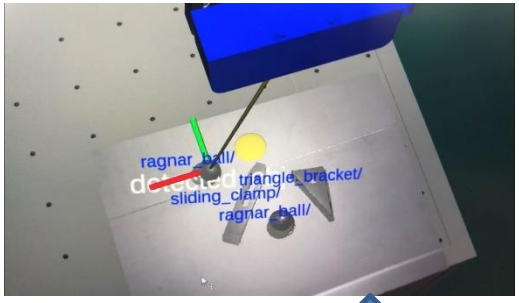
In-house

Problem Statement

Industrial robotic tasks are often constrained by specific hardware requirements.
Integration through 'traditional control system' is challenging and highly complex







ROS allows for real time visualization of sensor data

ROS drivers power the hardware

- Industrial conveyor, UR robot, Ensenso stereovision camera

ROS libraries process the data

- Point Cloud library performs object recognition and localisation
- Robot motion planning handled by Moveit.

ROS middleware

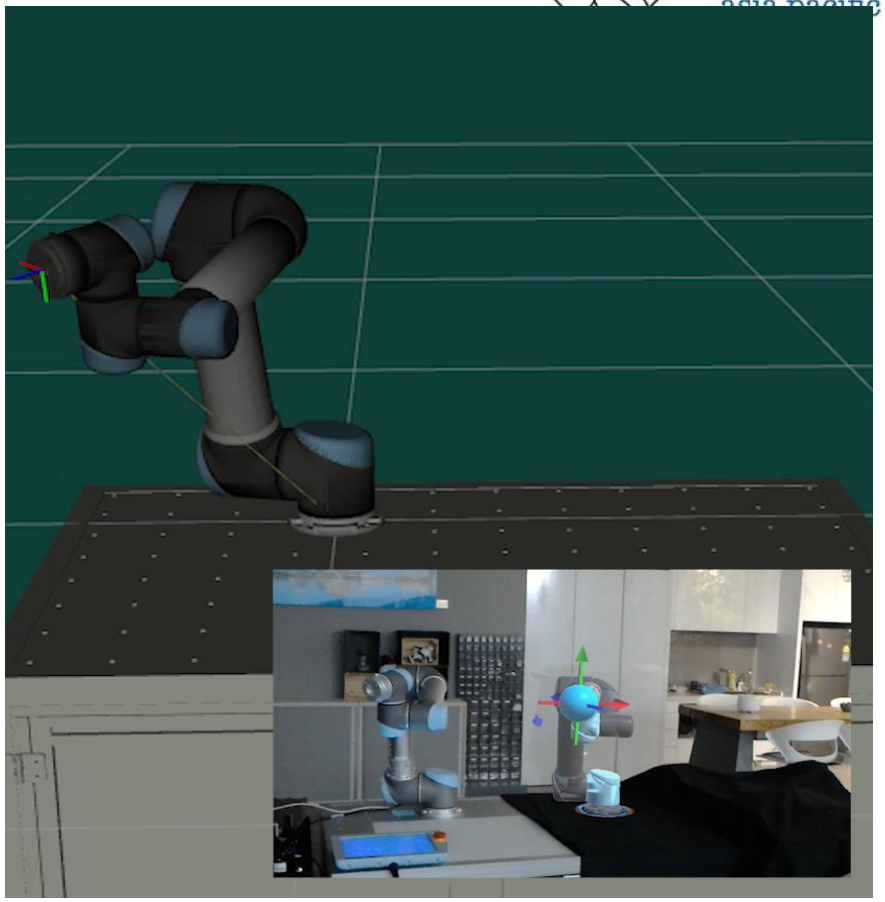
- Provides hardware agnostic communication to system components
- Significant reduction in complexity when changing hardware setup.

In-house

Mixed Reality Guided Robot Manipulation

Problem/Current Situation:

- Human Robot Collaboration required improved safety visualisation
- Scalability of robotic solution is hamper by the need of skilled engineers for programming



Approach: Simplified Robot Programming (SRP) – Phase 1

- Easy and interactive UI in Microsoft HoloLens
- Design translation tool to handle communication with ROS interface

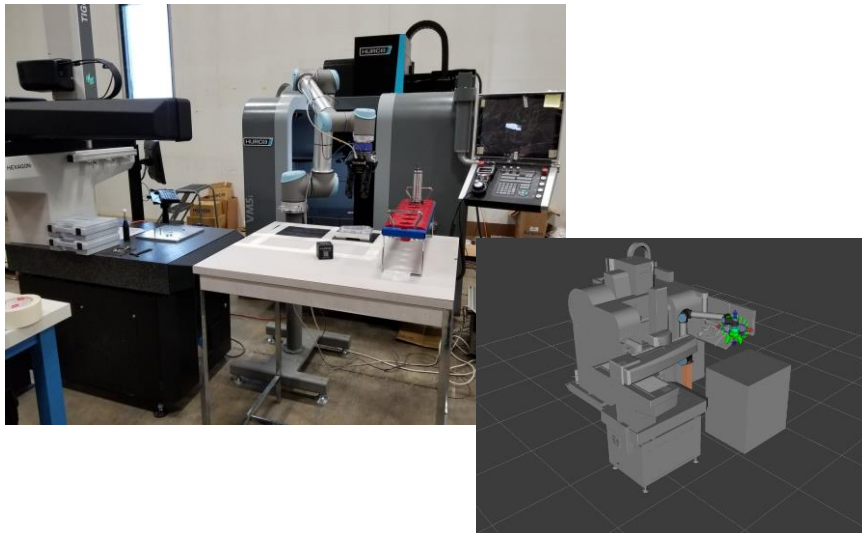
Challenges

- Require higher accuracy to meet application needs
- Need higher processing power for more complex application

Future Work:

- Future: build application specific libraries (picking, polishing, assembly etc)

MTConnect + ROS-I

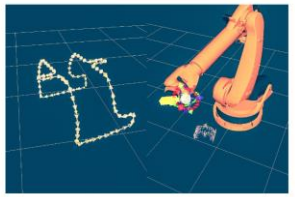


Demonstrate the ability to implement ROS-Industrial to program a robot and use MTConnect protocol for communications between the robot and a CNC machine tool

Collaboration between South West Research Institue with MTConnect, AMT, Hurco, Hexagon Metrology, and Universal Robots

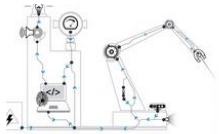
ROSIN, a project funded by the European Union's Horizon 2020 research and innovation programme

Focused Technical Projects (FTPs)



Software Quality Assurance

Education



HRIM: The Hardware Robot Information Model

Champion: Erle Robotics S.L., Spain

https://github.com/erlerobot/HRIM

Industrial trajectory generation for MoveIt!

Champion: Pilz GmbH & Co. KG, Germany

PAL ROBOTICS Statistics Framework

PAL Statistics Framework

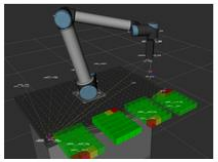
Champion: PAL Robotics, Spain

https://github.com/pal-robotics/pal_statistics

ROSweld

ROSWELD – ROS based framework for planning, monitoring and control of multi-pass robot welding

Champion: PPM AS, Norway



Pattern Manager

Champion: Danish Technological Institute. Denmark

ROL

Robotics Language

Champion: Robot Care Systems, Netherland

ROSinPS

ROS industrial indoor positioning system

Champion: İnovasyon Muhendislik

Visard4ROS – Easy to use 3D vision for robots

Champion: Roboception. Germany

Timeline of Events

2018

Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec

- **ROS-I Training (Singapore)** 29 Jan – 2 Feb
- **ROS-I Summer School (Singapore) – Singapore Poly** 12-16 Mar
- **RIC-Americas Annual Meeting** 7-8 Mar
- **ICRA 2018** 29 May – 3 Jun
- **ROS-I AP Workshop (Singapore)** 27 – 28 Jun
- **World ROS-I Day (Hackaton)** 10 – 11 July
- **ROS-I Developer Training (Singapore)** 27 – 31 Aug
- **ROSCON 2018 / IROS 29-30** Sept
- **World MoveIt! Day** 26 Oct
- **SIRE 2018** 1 – 2 Nov
- **ROS-I Developer Training (Singapore)** Dec TBC
- **ROS-I Conference** 11-13 Dec

Current

Training / Workshop

Annual Meeting Hackathon

Events

ROS-Industrial APAC Team

Our aim is to drive consistency over time

Create **Values** and **Trust**

SINGAPORE INTERNATIONAL ROBO EXPO - 2018 -

ROS industrial consortium asia pacific

RIDING OPPORTUNITIES IN EXPONENTIAL CHANGE

1 – 2 November 2018

Sands Expo & Convention Centre, Marina Bay Sands, Singapore

Themed 'Riding Opportunities in Exponential Change', the Singapore International Robo Expo (SIRE) aims to be a platform that creates opportunities for people to meet, connect and convert.

KEY HIGHLIGHTS

From R&D to Commercialisation

- A feature showcase of 07 cutting-edge robotic solutions by Dr. Mohan Rajesh Elara
  - Mantis, hTetro, sTetro and more!

Multi-Agency Panel Discussion

- First and only session featuring various sectors of the Singapore public service (i.e. Maritime and Port Authority of Singapore, Building & Construction Authority) convening on their requirements for robotics solutions

Startup Marketplace

Social Hub

SIRE Conference

Live Demo Zone

Expert Huddle Session

For any queries on event participation, please contact Ms Chloe Pung, Project Manager at chloepung@experiaevents.com

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