Robotics And Automation In The Energy Industry

John Allen

Industry Liaison

Allen Energy Consultants, LLC (AEC)

Subsea Systems Institute (SSI)

Texas Center of Excellence (RESTORE Act)

Overview:

A collaboration between the University of Houston, Rice University and NASA-Johnson Space Center, SSI pursues applied science and engineering technology development for offshore energy development, including improving sustainable/safe development, with a focus on the Gulf of Mexico (***remote locations***)

Mission:

Positively impact offshore safety and efficiency through engagement with industry to develop the best available technology and risk mitigation practices for the GoM; and support economic and workforce development.

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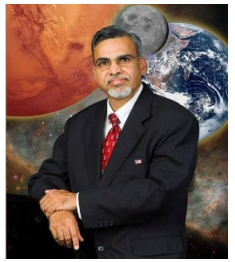

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Subsea Systems Institute (SSI)

Texas Center of Excellence (funded by the RESTORE Act)

To fulfill our mission, we have two programs –

a technology research program and

a workforce (economic development) program

Our challenge

What technology should we develop? **Will** and **how** can it be deployed?

research and industry collaboration

What are the barriers to deployment (what stop things being adopted)

and how can we shorten the deployment time from innovation

What are the skill sets needed to deliver new technology (do we need new skill sets)

We have performed road maps (with Industry) to make this assessment

Conventional and Alternative Energy-Offshore and Ocean Energy (&Hydrogen)

This project was paid for [in part] with federal funding from the Department of the Treasury through the State of Texas under the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act of 2012 (RESTORE Act).

The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the State of Texas or the Department of the Treasury.

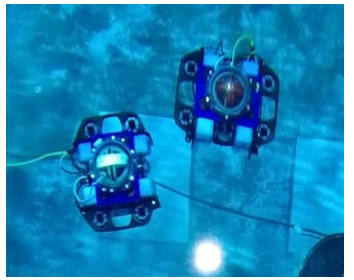
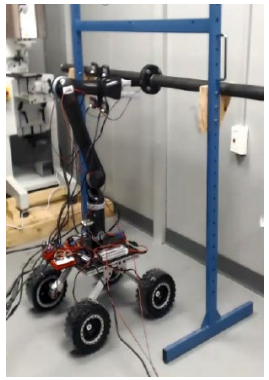
Workforce & Economic Development

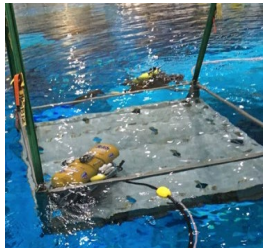
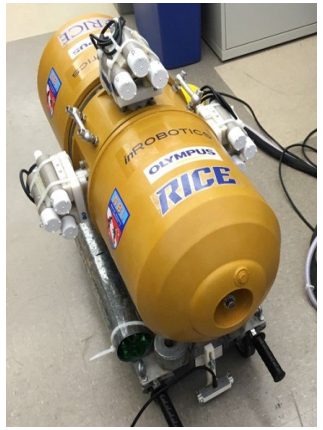
The Workforce and Economic Development program is designed to promote the safe and efficient use of offshore resources by training and upskilling current workers on the latest developments and deployment of technologies. The program will focus on stimulating workforce and economic development; job creation through technology development; and the establishment of workforce and entrepreneurship training programs that support safety and risk management and will train workers on the safe operation of new technologies and their field-scale implementation.

Workforce Development-Predicting the future

1) Training and certification for existing workforce with **evolving technology**
   a) Advisory committee
   b) Development and deployment of training programs
   c) Certification
2) Training for **Upskilling new technologies-carbon free O&G-Renewables and systems integration**
   a) Advisory committee
   b) Development of training for offshore asset monitoring systems, advanced offshore power deployment, and robotics and automation
3) Training and tools for risk management and risk assessment
   a) Analysis of human factors
   b) Development of risk management training
   c) Public dissemination of advancements

NASA Robotics Training collaboration

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COE Research Programs

Electrification Robotics Digitalization

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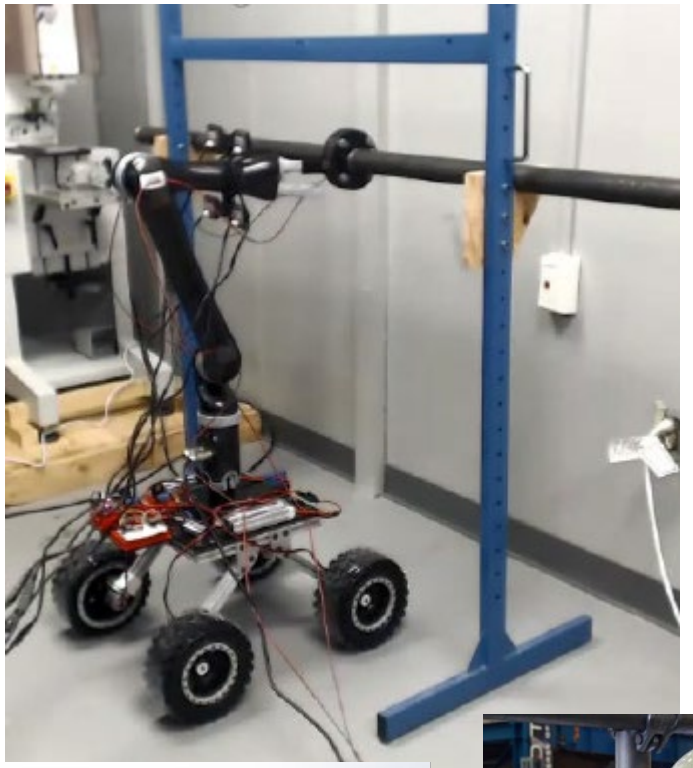
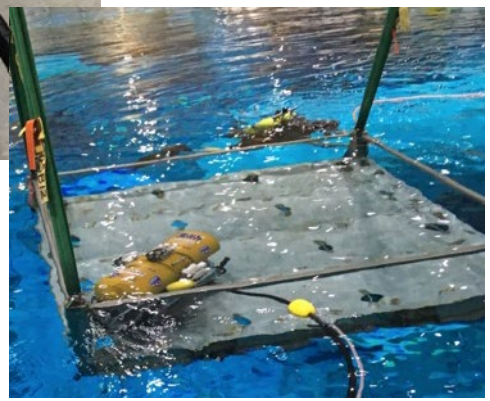
Robotics Research Projects



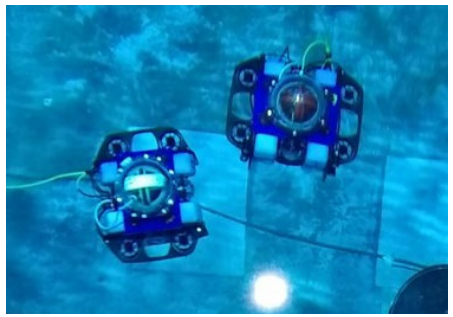
Identifying locating and sensing

Using tools

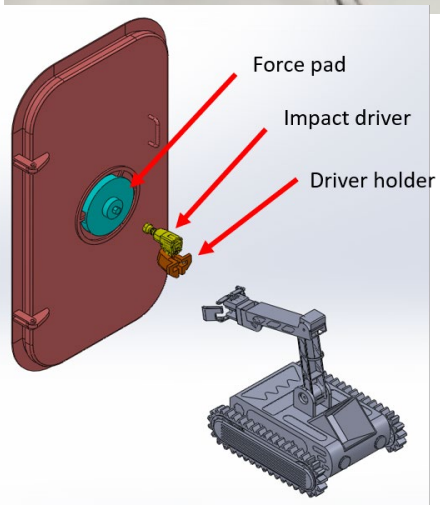
Learning Autonomy

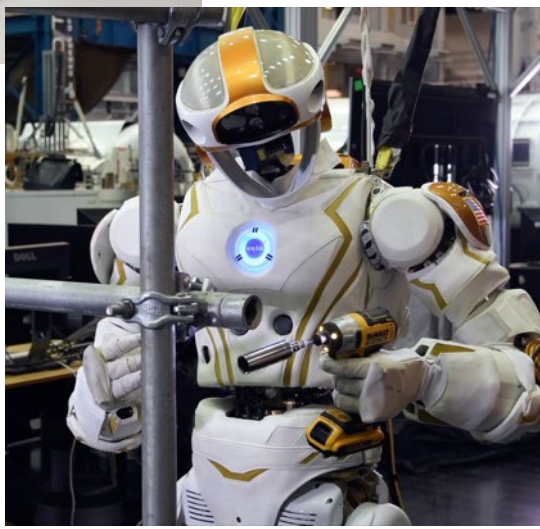


Innovation in flying/maneuvering and positioning



Communicating and collision avoidance
Managing swarms





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COE Robotics Program focus areas -*Gap mapping*

- **Sensing/communication**
  - **Shear wave acoustic**s; torque (connector/flanges) ,tactile, defects, antifouling, communications
  - **Fiber optics**: sensing pressure (temperature), acoustic waves, communications
  - **Electromagnetics**, anti collision, position accuracy, communication (close)
  - **Sensing for manipulation**, visual (cameras, tactile, deep learning)
  - **Communications challenges**
    - Full control with automated assist (full bandwidth)
    - Semi-autonomous with limited bandwidth
    - Autonomous with occasional and or delayed bandwidth-Mars program
- **Actuation**-using manipulator; augmented with (smart) tools to perform smart operations
  - Valve operation and flow sensing
  - Connectors and integrity (leakage/safety)
- **Underwater** /in fluids
  - Navigation location/Collision avoidance
  - Maneuvering Accurate Position (motive and sensing)
  - Station maintenance and power management Active Buoyancy
- **Platforms/land**
  - Mobility; transition over obstacles, door lip- moon rover derivatives
  - Smart manipulator and Smart tooling/standard (light mobile platform)
  - Autonomous accurate positioning/recognition
  - NASA Valkyrie conversion of smart manipulator (Valkyrie 'hand'/glove)
- **Drones, swarms, integration, digital twins**

The mapping process identified the need for innovation in:-

Communicating to (and between) Robots (and Autonomy)

Underwater **(flying) is well advanced particularly in tooling, but has opportunities in collision and swarms**

Land **has limitations in 'platform' mobility (getting through doors)**

Plenty of opportunity in smart tools (positioning and sensing) AI/Deep learning

Can we do better than people do 'safer, less errors, less accidents do things that can't be done' ***(people get tired get bored/distracted get stressed)***

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Finally and Back to Our challenge

What technology should we develop how can it be deployed-research and industry

What are the barriers to deployment

and how can we shorten the deployment time

What are the skill sets needed to deliver new technology (do we need new skill sets)

My story-the conundrum and our challenge

I was chief engineer of GEC Marconi responsible for offshore energy and the underwater vehicles program. Marconi was able to apply a wealth of aviation technology from fly by wire and then fly by light as used in aircraft automation (and subsequently unmanned and fully automated drone flight) ***to underwater vehicle/robotics****.*

Aviation 'automation' was driven in part due to complexity; the aircraft being 'unflyable' by humans (with highly maneuverable fighter airplanes being inherently non aerodynamic) and in part to remove the need for human involvement in flight operations (to concentrate on other things), Ostensibly, ***the vehicle is autonomous and the 'pilot' is the passenger****.(we have all heard of 'autopilot')*

Aerospace Heads up display and stereo viewing systems were also applied to human interaction with the underwater robots.

Application of Artificial Intelligence AI and learning

The reason why this is particularly interesting is

this was all done in the early 80's.

2021 (where are we now)

Modern underwater vehicles are (slowly) moving from offshore support to remote onshore supervision and with the support of unmanned surface vessels ***with increasing autonomy****.*

Robotics for (remote and) offshore installations supporting the power industry and energy harvesting from the oceans are growing in traction removing the need to put humans in this challenging environment.

This requires a level of autonomy with adaption to potentially non-contiguous communications (similar to the NASA challenge)

so 40 years later

the invention of GPS the micro chip

and smart phones (and technology is innovating ever faster)

why are we not doing this and why is this taking so long

Discussion Q&A