AUTONOMOUS SYSTEMS INITIATIVE

ASI Newsletter Volume 2 Issue 1 January 2021

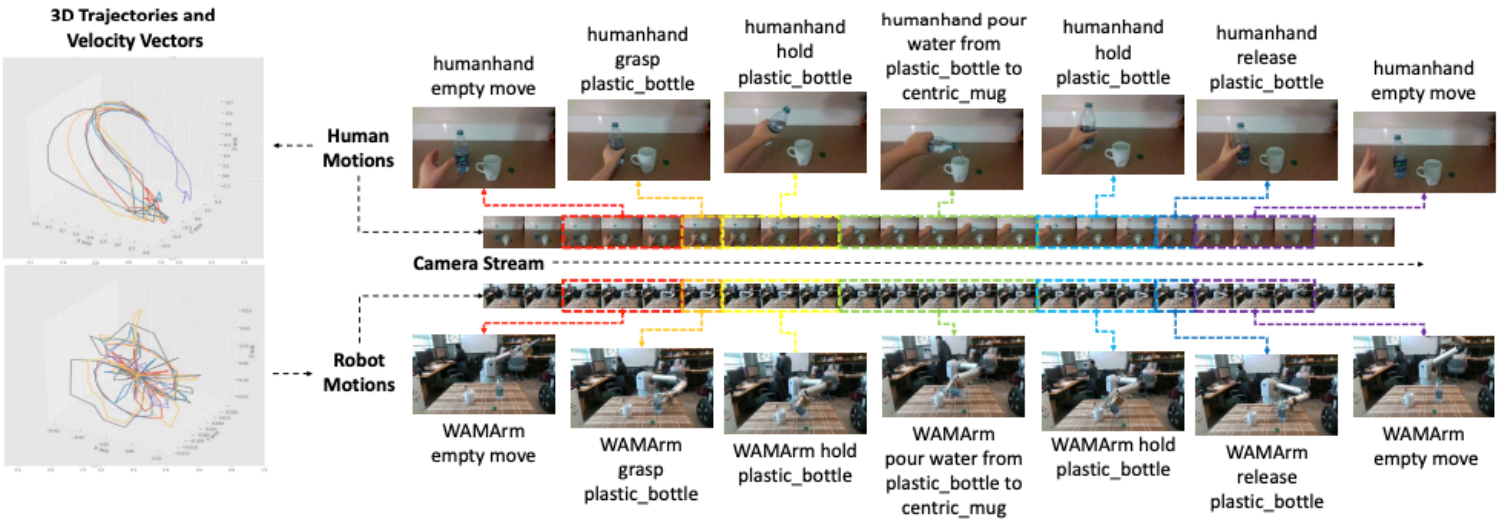
Welcome to 2021 and our first newsletter of the year. This month we focus on Theme 5 Industrial Communities and its partners in anticipation of its upcoming workshop February 2nd, 2021. Details for this event can be found at the end. We have a busy few months ahead, and we look forward to bringing you all the news.

Research Spotlight

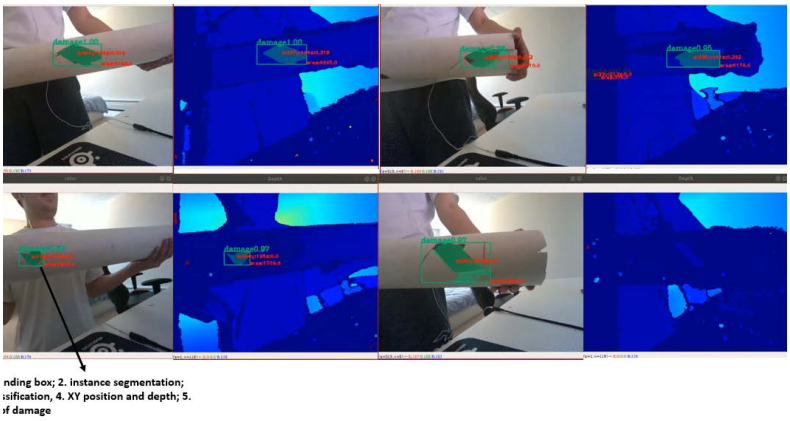
Working out in the industrial field, where the environment is harsh and locations are remote, is tough. The conditions for repair and maintenance in these instances are at best awkward and at most extremely hazardous, but autonomous systems offer ways to mitigate these difficulties.

ASI News and Updates

- ASI welcomes a newly formed Scientific Advisory Committee (SAC). To read about our new members, please visit our website.
- We also welcome several new members to our Strategic Advisory Board (SAB). You can find all of the members listed here.
- ASI Theme leader from Healthy Communities, Dr. Mahdi Tavakoli, has published new research on admittance-controlled robotic assistance. You can read the open access article here.



Manipulation data from both a human and robot arm, which includes the grasping, releasing, holding, and intending. Jiang.C et al. [2020], arXiv preprint arXiv:2003.01163.



Intel Real sense Depth Camera (D455) used to detect, segment, and locate the damaged areas with the help of an RGB-D camera.

A problem faced by many primary industries is the limiting capability to provide immediate response for repairing industrial components caused by severe environmental degradation (wear/corrosion) in remote areas that leads to component failures. The question of how this can be mitigated is a natural one, therefore, for ASI's Theme 5 Autonomous Systems for Industrial Communities whose focus is on in-situ repair and maintenance.

Headed by Dr. André McDonald and Dr. Rafiq Ahmad, both from the Department of Mechanical Engineering, and Dr. Martin Jägersand in the Department of Computing Science, this project brings together the cross-discipline perspectives to tackle the fundamental questions at the heart of this problem. Using their combined expertise, they aim to develop high entropy alloy (HEA) thermal spray coatings using semi-autonomous collaborative robots for damage inspection through vision-guided manipulation without on-site human intervention. In particular, they are investigating novel HEA thermal-sprayed coatings, which have the potential to curtail equipment degradation in harsh environments. The fascinating part of this work is the utilization of robot manipulators to perform in-field assessment/repair remotely by identifying damaged areas through vision-guided navigation.

The vision-guided autonomous system would essentially pave the way for sustainable industrial futures by analyzing the surfaces of damaged equipment in harsh wear and corrosion environments in remote areas. They utilize the robot manipulators to generate the toolpath for coatings deposition, which mitigate the impact of such conditions at immediate response. A robotic trajectory system should be utilized for spraying with the help of human-demonstrated visual geometric skill learning, where the robot approaches damaged areas for component repair without any extensive training dataset/human intervention to achieve full autonomy.

Crucially, the team works closely with important industrial partners who provide key information, guidance, and support. The work on this project has had valuable input from InnoTech Alberta, Imperial Oil, Cenovus Energy and Spence Corrosion. And this involvement is vital since in-situ in-field assessment/repair of components using autonomous systems will benefit the sustainability of industrial futures by eradicating the component's failure and result in cost-reduction. Semi-autonomous systems will find extensive use by industries situated in harsh environments to perform material deposition with the help of robot trajectory planning and visual feedback.

The potential is huge. Development of autonomous systems will further help achieve human-like behaviors across many fields, not only in manufacturing and the construction industries, but also healthcare and transportation. This offers these crucial areas of our community infrastructure – industry health and transportation – the potential to become safer and more efficient, improving our lives in both work and leisure.

The project is currently ongoing.

Dr. André McDonald, Prof. Mechanical Engineering, Assoc. Chair Mechanical; Dr. Martin Jägersand, Prof. Computing Science; Dr. Rafiq Ahmad, Asst. Prof. Mechanical Engineering; Rakesh Nair, PDF in Mechanical Engineering; Yufan Zhang, PDF in Mechanical Engineering; Masood Dehghanbanadaki, RA in Computing Science; Dhruv Sharma, RA in Computing Science; Harshavardhan Mamledesai, MSc student in Mechanical Engineering.

Partner Profile

In November, we featured ACAMP, one of ASI's important partners. For our New Year's edition, we focus on InnoTech Alberta, another key partner for ASI and Theme 5 Industry Communities in particular. We caught up with Gary Fisher, Principal Engineer at InnoTech, who told us more.

InnoTech ALBERTA

InnoTech Alberta, a subsidiary of Alberta Innovates, is a research and technology company that supports engineering and science in industry and the public sector. They specialize in accelerating and de-risking technology development and deployment. The organizations was established 100 years ago and has over 230 employees at four locations in Alberta.

More specifically, InnoTech Alberta provides engineering and scientific expertise to support industries in the province. When companies want to develop new technologies or solve particular problems, they may not have the facilities and expertise required. InnoTech has a wide range of facilities specifically tailored for Albertan industry and staff with technical expertise over a breadth of topics. Gary's role, for example, is as Principal Engineer with a focus on materials, having joined the company 18 years ago to establish capabilities in materials and manufacturing.

And this is how Gary connected with the Theme 5 Industry Communities team from ASI. InnoTech's role with ASI is focused on advanced manufacturing and materials, helping the research team to align technologies to applications and transition them into the commercial sector.

The organization sees Autonomous Systems as a useful tool for industries in the province, providing improvements to current practices and processes. They can be a way to improve efficiencies, safety and quality. InnoTech are keen to work with their industrial clients to adopt and use these types of technologies.

Gary Fisher is Principal Engineer at Innotech Alberta. For more information, please visit their website.

SAVE THE DATE: February 2nd 2021, 9am-2:45pm

The University of Alberta, Red Deer College, and InnoTech Alberta, in collaboration with the Autonomous Systems Initiative, are proud to present a Workshop on **Robotization of Industrial Repair and Manufacturing for Alberta: Promises and Pitfalls**.

This one-day event brings together industry, academia, and government to participate in interactive online engagement around cutting-edge materials, manufacturing, and repair strategies that feature integration of semi-autonomous robotic systems.

The event presents an excellent opportunity to learn about recent research and technology development through presentations, videos, online tours, and a live industry round table discussion. The Workshop will explore applications for manufacturing and autonomous repair in the Alberta resource sector.

This event is free but requires participants to register via Eventbrite. Please click here for the event page.

You can find a copy of the workshop agenda on our website.

This ASI workshop is hosted in conjunction with InnoTech Alberta.

Contact Us

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