This paper presents a new methodology for comparative analysis of collaborative robots for Industry 4.0. The key drivers in Industry 4.0 have evolved considerably since the last decades of the 20th century. Collaborative robots are one of the key drivers in Industry 4.0 and they have evolved considerably since the last decades of the 20th century. With respect to the industrial robotics, collaborative robots are more productive, flexible, versatile and safer. In the recent years, both market leading manufacturers of industrial robots and newer startup companies have developed novel products for collaborative robotic applications. This paper, we propose a methodology for developing a comparative analysis of the collaborative robots currently available in the market. The goal of the paper is to provide a framework for benchmarking alternative robots for a given collaborative application, based on common robot parameters and standardized experiments to be performed with the robots under investigation. An experimental technological review of three different collaborative robots is provided, showing how the methodology can be applied in real cases.

**Abstract**

In recent years, application fields such as industrial automation and indoor robot navigation increased the demand on reliable localization systems. Simultaneous mapping and localization systems often depend on depth imaging in order to reconstruct the scene. Time-of-Flight sensors prove to be well suited for these applications, however are impaired by different error sources. The measurement principle is based on measuring the phase and consequently the delay of emitted and reflected light. Specular surfaces can cause pixel saturation, while the periodicity of the measured phase leads to ambiguous distances. In this paper, we aim to solve these problems by proposing a new Time-of-Flight depth sensing approach. By combining the emerging coded modulation method with traditional depth sensing, we are able to unify the advantages of both methods. Images captured with coded modulation show a pixel response only within selected distance limits. In contrast to traditional continuous wave Time-of-Flight imaging, this method enables to mask erroneous distance measurements, allowing Time-of-Flight sensors to produce more reliable depth measurements and gain traction in the industrial environment. As our evaluation shows, our method is able to remove the influence of specular surfaces, and is capable of masking ambiguous distance measurements. Furthermore, our approach improves the system behaviour by enabling more robust exposure time control.

**Authors**

Federica Ferraguti, Andrea Pertos, Cristian Secchi, Cesare Fantuzzi and Marcello Bonib

1University of Modena and Reggio Emilia, IT; 2University of Ferrara, IT

**Abstract**

In this paper, we present a method to find an optimal trade-off between computation and communication of decentralized linear task chain running on a network of mobile agents. Task replication has been deployed to reduce the data links among highly correlated nodes in communication networks. The primary goal is to reduce or remove the data links at the cost of increase in computational load at each node. With increase in complexity of applications and computation load on end devices with limited resources, the computational load is not negligible. Our proposed selective task replication enables communication-computation trade-off in decentralized task chains and minimizes the overall local computation overhead while keeping the critical path delay under a threshold delay. We applied our approach to decentralized Unscented Kalman Filter (UKF) for state estimation in cooperative localization of mobile multi-robot systems. We evaluate and compare our proposed method on a network of 15 Raspberry PiB connected via Wi-Fi. Our experimental results show that, using the proposed method, the prediction step of decentralized UKF is faster by 15%, and for the same threshold delay, the overall computation overhead is reduced by 2.41 times. Compared to task replication without resource constraint.

**Authors**

Seyyed Ahmad Razavi, Elı Bozorgzadeh and Solmaz Kia, University of California, Irvine, US

**Abstract**

This paper presents a resource manager to achieve scalable performance in Robot Operating System (ROS) for distributed environments. In robotics, using ROS in distributed environments is a promising approach for large-scale data processing, for example, cloud/edge computing and the data communication of point clouds and images in dynamic map composition. However, ROS is unable to manage the resources on each host machine, e.g., the CPUs, memory, and disks. Therefore, it is difficult to efficiently use distributed environmental resources and achieve scalable performance. This paper proposes a resource management mechanism for ROS distributed environments using a master-slave model to efficiently and smoothly execute ROS process. We manage the resource usage of each host machine and construct a mechanism to adaptively distribute the load to be balanced. Evaluations show that scalable performances can be achieved in ROS distributed environments comprising ten host machines using a real application (SLAM: simultaneous localization and mapping) processing large-scale point cloud data.

**Authors**

Daisuke Fukutom, Takuya Azumi, Shinpei Kato and Nobuhiko Nishio

1Ritsumeikan University, JP; 2Satama University, JP; 3The University of Tokyo, JP

**Abstract**

HYBRID SENSING APPROACH FOR CODED MODULATION TIME-OF-FLIGHT CAMERAS

Authors:

Amin Schoenleib1, Hannes Plank1, Christian Steger1, Gerald Holweg2 and Norbert Drum3

1Infineon Technologies Austria, AT; 2Graz University of Technology, AT; 3Infineon Technologies Austria AG, AT

COMMUNICATION-COMPUTATION CO-DESIGN OF DECENTRALIZED TASK CHAIN IN CPS APPLICATIONS

Authors:

Seyyed Ahmad Razavi, Elı Bozorgzadeh and Solmaz Kia, University of California, Irvine, US

RESOURCES MANAGER FOR SCALABLE PERFORMANCE IN ROS DISTRIBUTED ENVIRONMENTS

Authors:

Daisuke Fukutom1, Takuya Azumi1, Shinpei Kato1 and Nobuhiko Nishio1

1Ritsumeikan University, JP; 2Satama University, JP; 3The University of Tokyo, JP

End of session
<table>
<thead>
<tr>
<th>Time</th>
<th>Label</th>
<th>Presentation Title</th>
<th>Authors</th>
</tr>
</thead>
</table>

Source URL: https://www.date-conference.com/conference/session/8.6