

Image Processing Laboratory



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Refereed academic journal

[naruse-301-015-01:2016] J. Ogawa K. Nakamura K. Naruse T. Matsumoto, Y. Oyama. Mechanism of generating drawbar pull of rod wheel on loose soil. *Artificial Life and Robotics*, pages 1–6, 2017.

In this paper, we propose a model of drawbar pull generated by wheels fitted with a rod and assess it by comparing measured values obtained from an experiment with those from the model. In recent years, many kinds of robots for weeding in paddy fields have been developed. However, almost all of these are large and heavy. We have previously developed a small, lightweight robot for weeding. This robot is equipped with a rod wheel that has roles of weeding and running. However, this wheel was developed by experience from demonstrations and its dynamics for control remain unknown. To solve this problem, we propose a new model for drawbar pull generated by rod wheels and evaluate it by comparing experimental values with those from the model.

[naruse-301-015-02:2016] K. Naruse Y. Watanobe K. Nakamura W. Chen, Y. Yaguchi. QoS-aware Robotic Streaming Workflow Allocation in Cloud Robotics Systems. *IEEE Transactions on Services Computing*, pages 1–1, 2018.

Computation offloading for cloud robotics is receiving considerable attention in academic and industrial communities. However, current solutions face challenges: (1) traditional approaches do not consider the characteristics of networked cloud robotics (NCR) (e.g., heterogeneity and robotic cooperation); (2) they fail to capture the characteristics of tasks in a robotic streaming workflow (RSW) (e.g., strict latency requirements and varying task semantics); and (3) they do not consider quality-of-service (QoS) issues for cloud robotics. In this paper, we address these issues by proposing a QoS-aware RSW allocation algorithm for NCR with joint optimization of latency, energy efficiency, and cost, while considering the characteristics of both RSW and NCR. We first propose a novel framework that combines individual robots, robot clusters, and a remote cloud for computation offloading. We then formulate the joint QoS optimization problem for RSW allocation in NCR while considering latency, energy consumption, and operating cost, and show that the problem is NP-hard. Next, we construct a data flow graph based on the characteristics of RSW and NCR, and transform the RSW allocation problem into a mixed-integer linear programming problem. To obtain a near-optimal solution in reasonable time, we also develop a heuristic algorithm. Experiments

comparing our approach with others demonstrate significant performance gains, with improved QoS and reduced execution times.

[yaguchi-301-015-01:2016] Niitsuma, Yuki and Torii, Syunpei and Yaguchi, Yuichi and Oka, Ryuichi. Time-segmentation and position-free recognition of air-drawn gestures and characters in videos. *Multimedia tools and applications*, 75(19):11615–11639, 2016.

We report the recognition in video streams of isolated alphabetic characters and connected cursive textual characters, such as alphabetic, hiragana and kanji characters, that are drawn in the air. This topic involves a number of difficult problems in computer vision, such as the segmentation and recognition of complex motion on videos. We use an algorithm called time-space continuous dynamic programming (TSCDP), which can realize both time- and location-free (spotting) recognition. Spotting means that the prior segmentation of input video is not required. Each reference (model) character is represented by a single stroke that is composed of pixels. We conducted two experiments involving the recognition of 26 isolated alphabetic characters and 23 Japanese hiragana and kanji air-drawn characters. We also conducted gesture recognition experiments based on TSCDP, which showed that TSCDP was free from many of the restrictions imposed by conventional methods.

Unrefereed academic journal

[yaguchi-301-015-02:2016] Moriya, Shusuke and Yaguchi, Yuichi. Ultrasound tongue image denoising for comparison of first and second language tongue trajectories. *The Journal of the Acoustical Society of America*, 140(4):3114–3114, 2016.

The main purpose of this research is to specify articulation difference between native and non-native speakers by digitizing tongue motions and analyzing the difference between utterances. Differences in tongue motion directly influence speaker's pronunciation; therefore, it may be possible to improve non-native speaker's efficiency of pronunciation practice with the relevant feedback and visualization. It is necessary for comparison of native and non-native speakers's tongue motions to that end, however, normalization is absolutely necessary to remove the influence of anything except tongue motion before comparison, because every person has a unique shape and size. In our previous research, we proposed normalization methods and some speaking errors were picked up automatically

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from tongue trajectory in ultrasound tongue image space. However, it is necessary to improve method to extract pure tongue trajectory with accuracy. In this paper, ultrasound tongue images are separated to 5x20 or 20x5 strip block. If tongue edge lies on the block, gray scale graduation forming a shape of an arch has occurred on a line of long side of block. We proposed some shape-sensitive filter to cut off an image noise which locates excepting neighborhood of tongue edge. Through our filter, tongue trajectory extracted from ultrasound tongue image could have less noises than previous one. However, some image noises locates on neighborhood of tongue edge are emphasized and inhibited comparison of native and non-native tongue trajectories.

Refereed proceedings of an academic conference

[naruse-301-015-03:2016] Keitaro Naruse. Problems of Remote Operating Robots and Robot Research Projects at Univ. of Aizu. In *The International Conference on Innovations in Info-business and Technology-2016 (ICIIT-2016)*, 2016.

Invited talk We can find robots not only in factories, but in our daily life such as autonomous clearing robots. However, it does not mean robot technologies are well matured. In this talk, current problems on robots and ongoing projects are explained, in particular for remote operated robots. As an instance, robotics research projects at the University of Aizu are presented, which include disaster respond robots, drones, agricultural robots, and so on.

[naruse-301-015-04:2016] Keitaro Naruse Cuong H. Pham, Yuich Yaguchi. Feature Descriptors: A Review of Multiple Cues Approaches. In *2016 IEEE International Conference on Computer and Information Technology (CIT)*, pages 310 – 315, 2016.

Feature descriptors have been playing an important role in many computer vision problems, such as image matching and object recognition. While classic descriptors using texture or shape as a single cue of descriptive information have been proved to be successful, recently, several approaches have been proposed introducing the combination of multiple cues to increase descriptive power and robustness. In this paper, we review the methodology of the most recent and popular multiple cues descriptors, and evaluate them with respect to their application and robustness to the variance of conditions.

[naruse-301-015-05:2016] Takashi Anazawa Taira Takahashi Keitaro Naruse

Keita Nakamura, Minoru Kimura. Investigation of weeding ability and plant damage for rice field weeding robots. In *2016 IEEE/SICE International Symposium on System Integration (SII2016)*, pages 899 – 905, 2016.

This paper reports our current development of Robo-ducky, the rice field weeding robots, which is inspired from rice farming with natural ducks. This paper presents (1) the improvement of motion ability of the robot by modifying the size of the robots, and (2) the investigation of weeding ability of the robot and damage put to rice plants in an agricultural scientific way such as counting up the number of seeds up from soil and defect rice plants according to the number of robot weeding. These investigations show the robot has enough weeding ability in an actual rice field.

[naruse-301-015-06:2016] K. Nakamura K. Naruse H. Nakazawa, J. Ogawa. Robot Sweep Path Planning with Weak Field Constrains under Large Motion Disturbance. In *Proc. of the second international symposium on swarm behavior and bio-inspired robotics (Swarm 2017)*, 2017.

Our research group has developed robot for a rice field (Aigamo robo). The motion of Aigamo robot is uncertainty by disturbance and robot damages to rice plants. We propose path planning method to solve this problem. Sweep field is separated square cells. Some robot can sweep all cells in sequence using the traditional sweep path planning. However, it is difficult and taking too much time for Aigamo robot because its motion is uncertainty. Aigamo robot cannot enter into the target cell, and robot sweep many times at same point when robot introduces it. Aigamo robot actually sweep every day. Aigamo robot can sweep upward another day when robot cannot sweep completely. Therefore, it is assumed that sweep rate of 80 percent is enough. We propose to reduce the number of visiting cells. The proposed method is realized that sweep rate is 80 percent or more and the damage to rice plants is smaller.

[naruse-301-015-07:2016] K. Nakamura K. Hamatani, J. Ogawa and K. Naruse. Distributed Localization by Camera Robots with Consensus Filter. In *Proc. of the second international symposium on swarm behavior and bio-inspired robotics (Swarm 2017)*, 2017.

This paper proposes a new self-localization method based on Extended Kalman Consensus Filter (EKCF) using only angular informations observed by many standing robots each other that are not controlled and that are dispersed in an environment as a localization method using only local information around robots. In

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a localization method by Extended Kalman Filter (EKF), to localize more dozen robots is difficult because matrix calculation are difficult for a regular computer. Therefore, to solve this problem a consensus is introduced to the EKF. Each EKF localize some robots in each EKF group and take consensus with each other to localize as a whole. To verify this method the numerical experiments were carried out and the effectiveness is confirmed.

[yaguchi-301-015-03:2016] C. H. Pham and Y. Yaguchi and K. Naruse. Feature Descriptors: A Review of Multiple Cues Approaches,. In *2016 IEEE International Conference on Computer and Information Technology (CIT)*,, pages 310–315, keywords=computer vision;image texture;shape recognition;computer vision;feature descriptors;image matching;multiple cues descriptors;object recognition;shape;texture;Feature extraction;Histograms;Image color analysis;Object recognition;Robustness;Shape;Three-dimensional displays;descriptors;multiple cues;review, Dec 2016,.

Finding the correspondences between images from a sequence has been one of the most important task in the fields of image processing, computer vision, and robotics. The idea of extracting a set of features (a.k.a. interested point or key-point) from the image, and describing a local region around each feature as a unique signature of the feature, so that it can be automatically found again in other images by its signature, is the most popular solution for the feature correspondence problem. Such local region descriptions are called feature descriptors.

Unrefereed proceedings of an academic conference

[yaguchi-301-015-04:2016] Keigo Anma and Yuichi Yaguchi and Yutaka Watanobe and Keitaro Naruse. Consideration of cloud robotics development base using RT middleware. In *SI2016*, pages 2557–2560, 2016.

[yaguchi-301-015-05:2016] Daishi Yoshino, Keigo Anma, Keitaro Naruse, Yuichi Yaguchi, Yutaka Watanobe, and Keita Nakamura. Implementation and application of Pub / Sub message communication of OpenRTM-aist using Solace. In *SI2016*, 2016.

[yaguchi-301-015-06:2016] Yukinori Inoue, Yuichi Yaguchi, Keitaro Naruse, Yutaka Watanobe, Kizuku Mineta, Hung Pham, Cuong, Keisuke Hamatani, Thisara Dharmasiri Pathberiyage, Venushka, Yoshiaki Oyama, Haruna

Nakazawa, Takaaki Mamiya, Taku Matsumoto, Keigo Anma, Daishi Yoshino, and Keita Nakamura. Development of sensor data collection base using RT components. In *SI2016*, 2016.

[yaguchi-301-015-07:2016] Shinichi Hashimoto and Yuichi Yaguchi and Keitaro Naruse and others. Three-dimensional wide area shape restoration from pixel-wise corresponding points. In *The 78th Information Processing Society of Japan Conference Presentation Papers*, volume 2016, pages 285–286, 2016.

[yaguchi-301-015-08:2016] Shinya Sato and Yuichi Yaguchi and Kyoko Okurdaira and Hirohide Demura and others. 3D-shape reconstruction of pores formed in silica airgel based on optical microscopic tomography. In *The 78th Information Processing Society of Japan Conference Presentation Papers*, volume 2016, pages 237–238, 2016.

[yaguchi-301-015-09:2016] Ikeda and Shun Sonoke and Shinya Sato and Yuji Takebuchi and Yuichi Yaguchi and Kyoko Okurdaira and Hirohide Demura and others. Shape estimation and volumetric calculation and its evaluation for penetration hole image of airgel using morphological operation. In *The 78th Information Processing Society of Japan Conference Presentation Papers*, volume 2016, pages 89–90, 2016.

Advisor for undergraduate research and graduate research

[yaguchi-301-015-10:2016] Satoshi Ishizuka. Graduation Thesis: Interface Generalization for Formation Flight by Different Manufacturer Drones, University of Aizu, 2016.

Thesis Advisor: Yuichi Yaguchi

[yaguchi-301-015-11:2016] Naoyuki Murata. Graduation Thesis: A Construction controll system for Kobuki using RGB-D SLAM, University of Aizu, 2016.

Thesis Advisor: Yuichi Yaguchi

[yaguchi-301-015-12:2016] Masashi Yoshida. Graduation Thesis: 3D Environment Map Reconstruction With Aerial Camera On A Drone, University of Aizu, 2016.

Thesis Advisor: Yuichi Yaguchi

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[yaguchi-301-015-13:2016] Yoshiaki Nitta. Graduation Thesis: Developing a general software interface for formation controlling drones, University of Aizu, 2016.

Thesis Advisor: Yuichi Yaguchi

[yaguchi-301-015-14:2016] Keisuke Moriuchi. Master Thesis: Comparison of Depth Camera Loading Drone Sequential Route Planning on 3D Space, University of Aizu, 2016.

Thesis Advisor: Yuichi Yaguchi

[yaguchi-301-015-15:2016] Shusuke Moriya. Master Thesis: Ultrasound Tongue Image Feature Extraction for Speaking Error Detection, University of Aizu, 2016.

Thesis Advisor: Yuichi Yaguchi

Contribution related to the creation of the annual schedule

[yaguchi-301-015-16:2016] A member of curriculum working group.

Contribution related to toward equipment management, classroom management, building management, and crime or fire prevention.

[yaguchi-301-015-17:2016] Management for facilities on Image Processing Lab.

Employment guidance

[yaguchi-301-015-18:2016] Advisor of Pokemon Circle, Soccer Circle and CUO.

Other significant contribution toward university planning, management, or administration

[yaguchi-301-015-19:2016] Member of Pasokon Koshien and chief of mobile section.

Contribution toward education for employees of regional industries

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[yaguchi-301-015-20:2016] Accepting collaboration research with Aquacrew