Eyþór Rúnar Eiríksson - DTU Orbit (31/12/2017)

Eyþór Rúnar Eiríksson

Organisations

National Space Institute
24/03/2011 → 07/04/2016 Former
eythor@eythor.is
VIP

Engineer, National Space Institute
03/09/2012 → 07/04/2016 Former
ere@space.dtu.dk
VIP

Electronic Engineering
04/09/2012 → 21/03/2014 Former
VIP

Postdoc, Department of Applied Mathematics and Computer Science
28/11/2013 → present
eruei@dtu.dk
VIP

Image Analysis & Computer Graphics
30/11/2013 → present
VIP

Publications:

Augmented Reality Interfaces for Additive Manufacturing
This paper explores potential use cases for using augmented reality (AR) as a tool to operate industrial machines. As a baseline we use an additive manufacturing system, more commonly known as a 3D printer. We implement novel augmented interfaces and controls using readily available open source frameworks and low cost hardware. Our results show that the technology enables richer and more intuitive printer control and performance monitoring than currently available on the market. Therefore, there is a great deal of potential for these types of technologies in future digital factories.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science , Image Analysis & Computer Graphics, Department of Mechanical Engineering, Manufacturing Engineering, Technical University of Denmark, MIT Media Lab
Authors: Eiríksson, E. R. (Intern), Pedersen, D. B. (Intern), Frisvad, J. R. (Intern), Skovmand, L. (Ekstern), Heun, V. (Ekstern), Maes, P. (Ekstern), Aanæs, H. (Intern)
Pages: 515-525
Publication date: 2017

Host publication information
Title of host publication: Scandinavian Conference on Image Analysis
Publisher: Springer

Series: Lecture Notes in Computer Science
Volume: 10269
ISSN: 0302-9743
Main Research Area: Technical/natural sciences
Conference: 20th Scandinavian Conference on Image Analysis, Tromsø, Norway, 12/06/2017 - 12/06/2017
3D Printing, Additive manufacturing , Augmented reality

Electronic versions:
ar_for_am.pdf

DOIs:
10.1007/978-3-319-59126-1_43

Publication: Research - peer-review › Article in proceedings – Annual report year: 2017
Computer Vision for Additive Manufacturing.
Ever since the commercialization of additive manufacturing in the late 80’s, it has been clear what enormous potential the technology could have, potentially disrupting several industries. However, we have yet to see the technology fully adopted by the manufacturing industry. One of the issues that has prevented widespread adoption of 3D printing for use within manufacturing is the apparent lack of quality control during and after the printing process. This thesis demonstrates how computer vision may be applied in beneficial ways within additive manufacturing. The main contributions aim at solving part of the challenges required for the technology to reach its full envisioned potential, and to reach widespread industry adoption as a de-facto manufacturing modality. Quality control has been a major milestone to overcome in this regard. As a result, a core part of the contributions revolves around this central topic. The work is separated into three main categories: The first two concerning process and quality control of appearance and geometry. The third category concerns machine interaction paradigms within additive manufacturing. Here, challenges are addressed within the 3D ecosystem, aiming towards facilitating a fluid integration of additive manufacturing within the factory of tomorrow.

In-line 3D print failure detection using computer vision
Here we present our findings on a novel real-time vision system that allows for automatic detection of failure conditions that are considered outside of nominal operation. These failure modes include warping, build plate delamination and extrusion failure. Our system consists of a calibrated camera whose position and orientation is known in the machine coordinate system. We simulate what the object under print should look like for any given moment in time. This is compared to a segmentation of the current print, and statistical detection of significant deviation. We demonstrate that this methodology precisely and unambiguously detects the time point of print failure.

Photogrammetry for Repositioning in Additive Manufacturing
In this preliminary work, we present our current status on how to use single camera photogrammetry to determine the orientation of an additively manufactured partly finished object that has been repositioned in the printing chamber, from a single image taken with a calibrated camera, and comparing this to the CAD model of the object.
PicPrint: Embedding pictures in additive manufacturing

Here we present PicPrint, a method and tool for producing an additively manufactured lithophane, enabling transferring and embedding 2D information into additively manufactured 3D objects. The method takes an input image and converts it to a corresponding height-map, indicating the material density required to achieve a brightness specified at any given location. Non-linear scattering properties are compensated for using predefined falloff profiles. Using the produced height-map, a watertight mesh is distorted to match the specified material densities, after which the mesh is ready for either direct print on an additive manufacturing system, or transfer to other geometries via Boolean mesh operations.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science, Image Analysis & Computer Graphics, Department of Mechanical Engineering, Manufacturing Engineering
Number of pages: 3
Publication date: 2017

Scene reassembly after multimodal digitization and pipeline evaluation using photorealistic rendering

Transparent objects require acquisition modalities that are very different from the ones used for objects with more diffuse reflectance properties. Digitizing a scene where objects must be acquired with different modalities requires scene reassembly after reconstruction of the object surfaces. This reassembly of a scene that was picked apart for scanning seems unexplored. We contribute with a multimodal digitization pipeline for scenes that require this step of reassembly. Our pipeline includes measurement of bidirectional reflectance distribution functions and high dynamic range imaging of the lighting environment. This enables pixelwise comparison of photographs of the real scene with renderings of the digital version of the scene. Such quantitative evaluation is useful for verifying acquired material appearance and reconstructed surface geometry, which is an important aspect of digital content creation. It is also useful for identifying and improving issues in the different steps of the pipeline. In this work, we use it to improve reconstruction, apply analysis by synthesis to estimate optical properties, and to develop our method for scene reassembly.

General information
State: Published
Organisations: Department of Physics, Neutrons and X-rays for Materials Physics

A self-calibrating robot based upon a virtual machine model of parallel kinematics

A delta-type parallel kinematics system for Additive Manufacturing has been created, which through a probing system can recognise its geometrical deviations from nominal and compensate for these in the driving inverse kinematic model of the machine. Novelty is that this model is derived from a virtual machine of the kinematics system, built on principles from geometrical metrology. Relevant mathematically non-trivial deviations to the ideal machine are identified and decomposed into elemental deviations. From these deviations, a routine is added to a physical machine tool, which allows it to recognise its own geometry by probing the vertical offset from tool point to the machine table, at positions in the horizontal plane. After automatic calibration the positioning error of the machine tool was reduced from an initial error after its assembly of ±170 µm to a calibrated error of ±3 µm. Excelling by speed, the calibration was executed in less than 3 min.

General information

State: Published
Organisations: Department of Mechanical Engineering, Manufacturing Engineering, Department of Applied Mathematics and Computer Science, Image Analysis & Computer Graphics
Authors: Pedersen, D. B. (Intern), Eiríksson, E. R. (Intern), Hansen, H. N. (Intern), Nielsen, J. S. (Intern)
Pages: 227-234
Publication date: 2016
Main Research Area: Technical/natural sciences

Publication information

Journal: Virtual and Physical Prototyping (Online)
Volume: 11
Issue number: 3
ISSN (Print): 1745-2767
Ratings:
Scopus rating (2016): SJR 0.661 SNIP 1.526 CiteScore 3.31
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 0.393 SNIP 0.825 CiteScore 1.23
Scopus rating (2014): SJR 0.477 SNIP 0.978 CiteScore 1.66
Scopus rating (2013): SJR 0.37 SNIP 0.697 CiteScore 1.17
Scopus rating (2012): SJR 0.216 SNIP 0.884 CiteScore 0.71
Scopus rating (2011): SJR 0.236 SNIP 0.669 CiteScore 0.77
Scopus rating (2010): SJR 0.31 SNIP 0.906
Scopus rating (2009): SJR 0.356 SNIP 0.753
Scopus rating (2008): SJR 0.396 SNIP 0.628
Scopus rating (2007): SJR 0.468 SNIP 0.734
Original language: English
Parallel kinematics, Delta robot, Machine calibration, Virtual machine, Additive manufacturing
DOIs:
10.1080/17452759.2016.1208363
Source: FindIt
Source-ID: 2306709233
Publication: Research - peer-review › Journal article – Annual report year: 2016
Designing for Color in Additive Manufacturing
In this paper we present a color design pipeline for 3D printed or additively manufactured parts. We demonstrate how to characterize and calibrate a commercial printer and how to obtain its forward and backward color transformation models. We present results from our assistive color design tool, allowing for colorimetric accurate prints and visualization of the printed outcome, prior to print. Lastly, we demonstrate our pipeline by accurately reproducing a real physical object.

GyroVR: Simulating Inertia in Virtual Reality using Head Worn Flywheels
We present GyroVR, head worn flywheels designed to render inertia in Virtual Reality (VR). Motions such as flying, diving or floating in outer space generate kinesthetic forces onto our body which impede movement and are currently not represented in VR. We simulate those kinesthetic forces by attaching flywheels to the users head, leveraging the gyroscopic effect of resistance when changing the spinning axis of rotation. GyroVR is an ungrounded, wireless and self contained device allowing the user to freely move inside the virtual environment. The generic shape allows to attach it to different positions on the users body. We evaluated the impact of GyroVR onto different mounting positions on the head (back and front) in terms of immersion, enjoyment and simulator sickness. Our results show, that attaching GyroVR onto the users head (front of the Head Mounted Display (HMD)) resulted in the highest level of immersion and enjoyment and therefore can be built into future VR HMDs, enabling kinesthetic forces in VR.

In-Situ Monitoring in Additive Manufacturing Using Contact Image Sensors

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science , Image Analysis & Computer Graphics, Department of Mechanical Engineering, Manufacturing Engineering
Pages: 98-102
Publication date: 2016

Host publication information
Title of host publication: Proceedings of the ASPE/euspen 2016 Summer Topical Meeting on Dimensional Accuracy and Surface Finish in Additive Manufacturing
Publisher: ASPE – The American Society for Precision Engineering
ISBN (Print): 978-1-887706-71-1
Main Research Area: Technical/natural sciences
Publication: Research - peer-review › Article in proceedings – Annual report year: 2016

GyroVR: Simulating Inertia in Virtual Reality using Head Worn Flywheels
We present GyroVR, head worn flywheels designed to render inertia in Virtual Reality (VR). Motions such as flying, diving or floating in outer space generate kinesthetic forces onto our body which impede movement and are currently not represented in VR. We simulate those kinesthetic forces by attaching flywheels to the users head, leveraging the gyroscopic effect of resistance when changing the spinning axis of rotation. GyroVR is an ungrounded, wireless and self contained device allowing the user to freely move inside the virtual environment. The generic shape allows to attach it to different positions on the users body. We evaluated the impact of GyroVR onto different mounting positions on the head (back and front) in terms of immersion, enjoyment and simulator sickness. Our results show, that attaching GyroVR onto the users head (front of the Head Mounted Display (HMD)) resulted in the highest level of immersion and enjoyment and therefore can be built into future VR HMDs, enabling kinesthetic forces in VR.

General information
State: Published
Organisations: Department of Applied Mathematics and Computer Science , Image Analysis & Computer Graphics, University of Ulm, MIT Media Lab
Authors: Gugenheimer, J. (Ekstern), Wolf, D. (Ekstern), Eiríksson, E. R. (Intern), Maes, P. (Ekstern), Rukzio, E. (Ekstern)
Pages: 227-232
Publication date: 2016

Host publication information
Title of host publication: Proceedings of the 29th Annual Symposium on User Interface Software and Technology (UIST ’16)
Publisher: Association for Computing Machinery
ISBN (Print): 978-1-4503-4189-9
BFI conference series: User Interface Software and Technology (5000294)
Main Research Area: Technical/natural sciences
Conference: 29th Annual Symposium on User Interface Software and Technology (UIST ’16), Tokyo, Japan, 16/10/2016 - 16/10/2016
GyroVR, Haptics, Virtual reality, Mobil VR, Nomadic VR
DOIs:
10.1145/2984511.2984535
Source: PublicationPreSubmission
Source-ID: 126653718
Publication: Research - peer-review › Article in proceedings – Annual report year: 2016

In-Situ Monitoring in Additive Manufacturing Using Contact Image Sensors

General information
State: Published
Organisations: Department of Mechanical Engineering, Manufacturing Engineering, Department of Applied Mathematics and Computer Science , Image Analysis & Computer Graphics
Precision and Accuracy Parameters in Structured Light 3-D Scanning

Structured light systems are popular in part because they can be constructed from off-the-shelf low cost components. In this paper we quantitatively show how common design parameters affect precision and accuracy in such systems, supplying a much needed guide for practitioners. Our quantitative measure is the established VDI/VDE 2634 (Part 2) guideline using precision made calibration artifacts. Experiments are performed on our own structured light setup, consisting of two cameras and a projector. We place our focus on the influence of calibration design parameters, the calibration procedure and encoding strategy and present our findings. Finally, we compare our setup to a state of the art metrology grade commercial scanner. Our results show that comparable, and in some cases better, results can be obtained using the parameter settings determined in this study.

Predicting Color Output of Additive Manufactured Parts

In this paper we address the colorimetric performance of a multicolor additive manufacturing process. A method on how to measure and characterize color performance of said process is presented. Furthermore, a method on predicting the color output is demonstrated, allowing for previsualization of parts prior to print. Results show that color prediction can be achieved with an average color difference error of ΔE*00 = 1.5 and std.dev σ= 0.75, with similar order of magnitude as the literature defined threshold for „Just Noticeable Difference” (JND).
Quality Assurance Based on Descriptive and Parsimonious Appearance Models

In this positional paper, we discuss the potential benefits of using appearance models in additive manufacturing, metal casting, wind turbine blade production, and 3D content acquisition. Current state of the art in acquisition and rendering of appearance cannot easily be used for quality assurance in these areas. The common denominator is the need for descriptive and parsimonious appearance models. By ‘parsimonious’ we mean with few parameters so that a model is useful both for fast acquisition, robust fitting, and fast rendering of appearance. The word ‘descriptive’ refers to the fact that a model should represent the main features of the acquired appearance data. The solution we propose is to reduce the degrees of freedom by greater use of multivariate statistics.

Spatial Accuracy of Embedded Surface Coloring in Color 3D Printing

Recent years, the industrial market for full-colorAM is growing rapidly. In the AM industry, most of the major technology providers are developing new systems with improved color capabilities and with improved materials. In the last 12 months alone, 5 new technology platforms have been revealed capable of full-color printing in polymers[1]. Industrial service providers increasingly expand their product-range of full color print services, and as of today, the industry for full-color parts has grown rapidly, into a million-dollar industry [2]. With a new market emerging at such pace, it is believed a necessity to consider a new surface-metrological issue. To what accuracy are colors embedded to the surface of geometries, with relation to where specified from input data? This paper investigate the accuracy of surface coloring, by adopting a well-known metrological approach from calibrating Coordinate Measurement Machines(CMM’s) and Machine Tools, that already has been transferred to be applicable for AM machine tools, [3] in order to determine the spatial accuracy of embedded color features to artifacts printed on a zCorp 650 color 3D Printer. The spatial color verification artifact is a flat plate with a series of checkered fields on the surface.
VirtualTable: a projection augmented reality game

VirtualTable is a projection augmented reality installation where users are engaged in an interactive tower defense game. The installation runs continuously and is designed to attract people to a table, which the game is projected onto. Any number of players can join the game for an optional period of time. The goal is to prevent the virtual stylized soot balls, spawning on one side of the table, from reaching the cheese. To stop them, the players can place any kind of object on the table, that then will become part of the game. Depending on the object, it will become either a wall, an obstacle for the soot balls, or a tower, that eliminates them within a physical range. The number of enemies is dependent on the number of objects in the field, forcing the players to use strategy and collaboration and not the sheer number of objects to win the game.

Projects:

Computer Vision based geometrical and textural control for 3D print and injection moulding processes

Department of Applied Mathematics and Computer Science
Period: 01/12/2013 → 29/09/2017
Number of participants: 6
Phd Student:
Eiríksson, Eyþór Rúnar (Intern)
Supervisor:
Pedersen, David Bue (Intern)
Main Supervisor:
Aanaæs, Henrik (Intern)
Examiner:
Carstensen, Jens Michael (Intern)
Krüger, Norbert (Ekstern)
Taylor, John (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering

Relations
Publications:
Computer Vision for Additive Manufacturing.
Project: PhD