Activity Report 2020

Mar., 2021

Graphics Literacy Education and Research Center
Graduate School of Engineering
Kobe University

Objectives of Establishing the Graphics Literacy Education and Research Center

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Keywords: Graphics Literacy, Education, Center, Establishment, Objectives

The Graphics Literacy Education and Research Center (GLEC) was established in April 2020 as an affiliated research center of the Graduate School of Engineering. The “Objectives and Purposes of GLEC” and “Needs for GLEC” in the “Report on Establishment of an Affiliated Center” are described as follows.

Objectives and Purposes of GLEC

“Encompassing urban and architectural planning, environmental and energy management, and industrial design, the center focuses on basic studies, groundbreaking education of leading-edge knowledge, and research practice, including aesthetic examinations of interdisciplinary and multiscale graphics literacy for all areas. With young faculty members playing a central role, the center widely introduces the results of individual research and educational practices to the outside world.”

Needs for GLEC

“It has been demonstrated in history that truly valuable objects are not only functional but also have value from an aesthetic perspective. With this in mind, we conduct integrated research based on aesthetics, graphic science, and other studies that form the basis of design. While reflecting this in education, it is necessary to cultivate human resources that have both a scientific perspective for pursuing high functionality and an aesthetic sense of value.”

As described above, the keywords of GLEC are multiscale, interdisciplinary, comprehensive, aesthetics, and graphic science.

Graphic science focuses on learning a technique called projection to display a three-dimensional object on a two-dimensional surface. It was introduced in the Meiji Period as a subject to be studied by science and engineering students involved in manufacturing. It has been considered as a means to design and produce “objects” as final products, focusing on exercising hand drawing of figures (hand-drawn graphic science). However, the introduction of computers in the 1990s resulted in an expansion of graphic science to include games and animations, and high-quality figures in computer graphics (CG) came to be considered final products. Since the 2000s, research and education using origami techniques and 3D printing have been blooming, reinforcing the relationship with manufacturing. The main work of GLEC is reorganizing the graphic science taught at our university to provide educational content befitting the new era. Hence, as shown in Fig. 1, we define "draw," "manufacture," and "measure" as three areas of literacy that should be acquired by students of engineering, and GLEC will provide education, considering utilization of the associated knowledge and technology (e.g., CAD/CG, 3D printing, 3D scanning, and drone surveying) in various scales and fields.

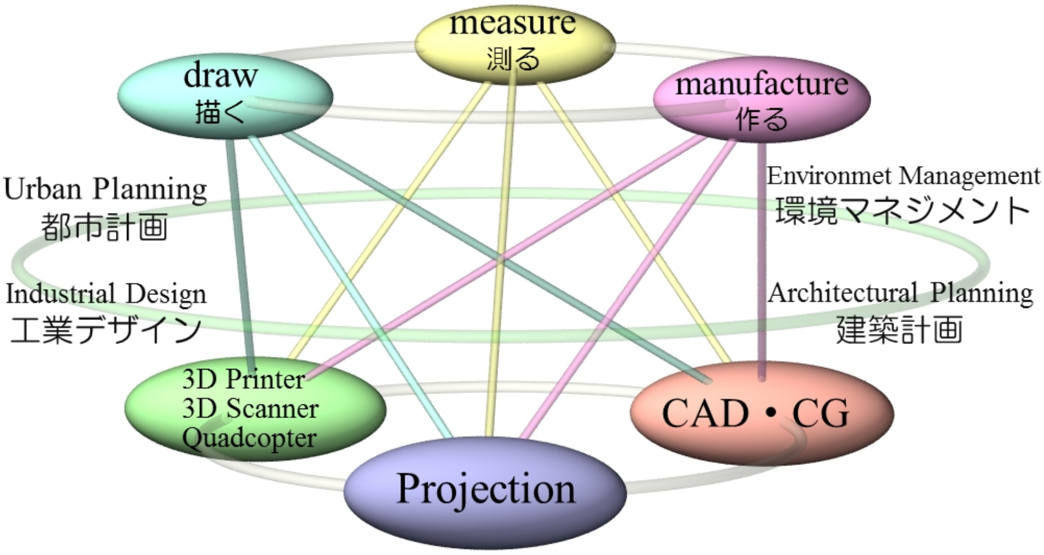

Fig. 1. Education provided by GLEC

In relation to this, the course contents of Graphics Literacy A and D, scheduled to be offered from FY 2021, are described in a separate article (Graphics Literacy B and C are planned to be hand-drawn graphic science). GLEC was launched under various coronavirus-related restrictions. Amid a condition that completely overturned the previously existing way of spatial design, GLEC held a public competition to solicit spatial designs and technology proposals that would help people associate with each other in a space where people gather while maintaining social distance. This is also described in a separate article. Furthermore, a lecture series "Understanding Complex Phenomena through Graphical Representations" is being held for the purpose of giving back to society regarding graphics technology and is described in separate articles.

A ceremony to celebrate the opening of GLEC will be held on March 24, 2021, with seminars inviting prominent graphics researchers from Japan and abroad. At the same time, a graphics exchange meeting will take place by using avatars to explore the ways of communication using graphics technology under the coronavirus pandemic.

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Public Competition “Staying Connected While Apart” for Maintaining “Social Distancing”

Hirotaka SUZUKI[1], Kenzo TAGA[1] and Kimihiro SAKAGAMI[1]

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Keywords: Social Distance, Public Competition, University Campus, Spatial Design, Technical proposal

As a part of a countermeasure against the COVID-19 pandemic, the public has been called on to avoid the “three Cs,” which means closed spaces, crowded places, and close-contact settings. Reflecting on the history of pandemic outbreaks in the past leads us to think this kind of constraint will last for an extended period of time in various fields of society, and the world may never return to pre-pandemic life. Traditionally, the field of spatial design placed a high value on ideas that actively promote and nurture connection, activeness, and connectedness. However, because these concepts are mutually related to the “three Cs,” the field of spatial design will be confronted with a paradigm shift in the future.

Against this backdrop, we held this competition to identify innovative ideas centering on the theme of “Staying Connected While Apart,” looking ahead to the post-COVID-19 era. The theme of this competition is to design a space on campus to convey the university as a space available for both experimental research activities and recreational activities for the local communities. The objective of this competition is to provide support to participants in realizing their outstanding proposals while evaluating their effectiveness. In addition to spatial design (Category A), this competition also invited technical engineering proposals as Category B in the fields of mechanical/electrical/information engineering, applied chemistry, or the combination of those, in order to realize a well-developed open space that meets the social distancing requirements.

This competition was publicly announced on July 14, 2020, and we received 10 proposals for Category A, and 3 proposals for Category B by the deadline on September 7, 2020. After the selection stage, prizes were given as follows: 1 First Prize winner and 2 Award of Excellence winners in Category A; 1 First Prize winner in Category B. Please refer to the following pages that include the call for entries leaflet and reports on the competition results for details on the invitation to the competition, judging criteria and feedback, and winners. The award ceremony was held on October 29, 2020. As shown in Photos 1 to 4, prize-winning individuals /groups received the certificate of merits from Professor Naoto Ohmura, the Dean of the Engineering

Research in Architecture. Currently, mockup making and other preparations are undertaken to realize the First Prize proposals.

Fig. 1. First Prize in Category A (spatial design): Kotoko Onishi, So Yo. Awarded proposal: “Fluctuation of Waves： Distanced yet Connected by the Wave Bench”

Fig. 2. First Prize in Category B (technical engineering): Kentaro Emura, Hiroaki Aoki, Kota Kirinoe, Haruka Yagyu, Kai Washino, Sotaro Nishihara, Natsumi Matsui. Awarded proposal: “Social Mile Post: Mile Post for Connecting While Distancing”

Fig 3. Award of Excellence in Category A (spatial design): Satoshi Nagamoto, Ryo Nishimura, Miyu Iwahashi, Risa Kizaki, Kento Shu, Sae Matsushita, Hinako Yamajo, Suzu Sakamoto, Aoi Yonemitsu. Awarded proposal: “In the Right Middle of a House and an Open Field”

Fig 4. Award of Excellence in Category A (spatial design): Akihiro Koike. Awarded proposal: “Embellishing the Place with ‘Places of Dancing Colors’”

Fig 5. Group photo after the award ceremony

Public Competition
Flyer

Public Competition “Staying Connected While Apart”

Invitation of proposals for the open space at Kobe University’s Faculty of Engineering

Today, we are requested to avoid the so-called “three Cs:” closed spaces, crowded places, and close-contact settings, as a part of a countermeasure against the COVID-19 pandemic. Reflecting on the history of pandemic outbreaks in the past leads us to think this kind of constraint will last for an extended period of time in various fields of society, and the world may never return to pre-pandemic life. Traditionally, the field of spatial design placed a high value on ideas that actively promote and nurture connection, activeness, and connectedness. However, because these concepts are mutually related to the “three Cs,” the field of spatial design will be confronted with a paradigm shift in the future.

Against this backdrop, we hold this competition to identify innovative ideas centering on the theme of “Staying Connected While Apart,” looking ahead to the post-COVID-19 era. The theme of this competition is to design a space on campus to convey the university as a space available for both experimental research activities and recreational activities for the local communities. The objective of this competition is to provide support to participants in realizing their outstanding proposals while evaluating their effectiveness. In realizing a well-developed open space that meets the social distancing requirements, this competition not only calls for proposals in spatial design (Category A), but also in technical engineering as Category B in the fields of mechanical/ electrical/ information engineering, applied chemistry, or the combination of those.

Space to be designed

An open space at the south side of the Faculty of Engineering No.3 building at Kobe University

Categories

Category A: Spatial Design / Category B: Technical Engineering Proposal

Prizes

- Category A: First Prize (1 proposal) / Honorable Mention (a few proposals)
- Category B: First Prize (1 proposal) / Honorable Mention (a few proposals)

First Prize winners will receive 250,000 Yen for Category A and 100,000 Yen for Category B for the realization of the proposals.

Submission Requirements

- The resolution of submitted materials must be higher than 350pi.
- Category A: the proposal must fit in 1 sheet in A1 size (PDF format) with concept description, drawings, perspective images, and photos.
- Category B: the proposal must fit in 1 sheet in A3 size (PDF format) with written description of the proposing engineering idea, with supporting diagrams.
- For submissions to both categories, please attach the application form that may be downloaded from the following link.
  http://www.research.kobe-u.ac.jp/eng-glec/form.xls

Method of submission and deadline

Save the submission materials on a DVD or a CD disc and forward it to the following address (must arrive no later than September 7, 2020). A printed copy of the proposal is not required for submission, except the printed application form.

Addressee:

Public Competition Committee, Graphics Literacy Education and Research Center, Faculty of Engineering, Kobe University

1-1, Rokkodai-cho, Nada-ku, Kobe city, 657-8501, Hyogo prefecture, JAPAN

Qualification

Undergraduate / graduate students at Kobe University. Individual(s) or group(s) who can realize their proposal upon winning the First Prize in each category.

Others

- Both proposals with “highly feasible” and “not highly feasible but appraisable” ideas will be assessed and appraised, while the First Prize will be given to the concept with high feasibility. When submitting a proposal with high feasibility, please also include a cost proposal as a submitting material.
- The juries evaluate not only the universality of the proposed designs and engineering ideas for realizing the concept “Staying Connected While Apart” that looks ahead to the post-COVID-19 era, but also the compatibility of the proposals with the special conditions of the space to be redesigned.
- Copyright of the submitted proposal belongs to the submitting individual / group. However, the organizer of the competition and the Graduate School of Engineering hold the right to use the data of submitted proposals free of charge in cases where they publish or exhibit the

proposals on a website or other media.

Announcement of evaluation results

The results will be announced at the following link on September 30, 2020:
http://www.research.kobe-u.ac.jp/eng-glec/

Awards juries

Category A: Shuhei Endo, Naoto Ohmura, Atsushi Koike, Kenzo Taga, Ichiro Nagasaka, Naoko Kuriyama, Ken Nakae, Tamotsu Asai, Keiko Gion.
Category B: Yoshitada Isono, Masatoshi Kitamura, Kimihiro Sakagami, Nobutaka Kuroki, Hirotaka Suzuki, Akira Takada, Yuichiro Yamabe

Contact

eng-glec@research.kobe-u.ac.jp

Host

Graphics Literacy Education and Research Center, Faculty of Engineering, Kobe University

Public Competition for Maintaining Social Distancing: "Staying Connected While Apart"
Category A (Spatial Design) Evaluation Results

September 30, 2020
Category A (spatial design) chief jury
Kenzo Taga (Professor of the Graduate School of Engineering)

Category A (Spatial Design)
First Prize
Kotoko Onishi, So You
"Fluctuation of Waves: Distanced yet Connected by the Wave Bench"

Image photos of submitted proposal (extracted from the submitted PDF)

Award of Excellence

Satoshi Nagamoto, Ryo Nishimura, Miyu Iwahashi, Risa Kizaki, Kento Shu, Sae Matsushita, Hinako Yamajo, Suzu Sakamoto, Aoi Yonemitsu. Awarded proposal: “In the Right Middle of a House and an Open Field”

Image photos of the submitted proposal (extracted from the submitted PDF)

Award of Excellence

Akihiro Koike

“Embellishing the place with ‘places with dancing colors’”

Image drawing of the submitted proposal (extracted from the submitted PDF)

The theme of this competition is to design a space on campus to convey the university as a space available for both experimental research activities and recreational activities for the local communities. The objective of this competition is to provide support to participants in realizing their outstanding proposals while evaluating their effectiveness.

This competition was announced on July 14, 2020, and 10 proposals were submitted by the deadline on September 7, 2020. For the Spatial Design category, a jury of 9 people (Shuhei Endo, Naoto Ohmura, Atsushi Koike, Kenzo Taga, Ichiro Nagasaka, Naoko Kuriyama, Ken Nakae, Tamotsu Asai, and Keiko Gion) examined and evaluated the submitted proposals. The first round of evaluation was conducted to give 5 levels of grading from 1 to 5, from the viewpoints of design quality, compatibility with the site, originality, feasibility, and the potential for universality. The second round of evaluation was conducted in the form of online discussion in which 9 juries gave critique for each proposal, describing the evaluation criteria and proposals that they regarded highly. After those rounds of evaluations, the chairperson of the jury suggested the following evaluation method: 7 proposals that received more than 60 points (the average of the grand total is converted into 100 points scoring) in the 1st round of evaluation were selected for voting by jury members as the 1st voting round; each jury has 3 points with the chances to vote for 3 proposals. As a result of the 1st voting round, 1 proposal received unanimous points, and this proposal was awarded the First Prize at this point; among those 6 remaining proposals, 2 proposals did not receive any point in the 1st round of voting so they were excluded; juries conducted the 2nd round of voting with those 4 remaining proposals where each jury was given 1 point to vote for 1 proposal; 2 proposals received higher points than the others, therefore they acquired the Award of Excellence. While the outline of this competition mentioned that the First Prize shall be given to 1 proposal and an Honorable Mention will be given to a few proposals, those 2 proposals selected in the 2nd round of voting were very highly regarded among juries, so they were awarded with the Award of Excellence prize instead of the Honorable Mention prize.

The proposal that received the First Prize, “Fluctuation of Waves: Distanced yet Connected by the Wave Bench” received high praise for its well-developed design that ingeniously connects the action of sitting down on a bench to the action of maintaining distance from each other, thoughtful allocation of benches that prevents people from facing each other, a good harmony of the design with the site, and the design of sightlines.

The proposal that received the Award of Excellence, “In the Right Middle of a House and an Open Field” was highly praised for its novelty and the quality of the design expected to be utilized among various generations. Another proposal receiving the Award of Excellence, “Embellishing the Place with places of Dancing Colors’” was highly regarded for its originality, compatibility with face masks / face shields, and responding to the conditions under the COVID-19 pandemic by intentionally taking a direction without placing any seating on site.

Regarding the installation of benches and poles based on the First Prize proposals, some requests were made to the winners to ensure the safe usage of the site with consideration to the cases where the site is used during holidays when the site administrator cannot keep an eye on the safety of visitors. They were requested to ensure safety by thoroughly discussing with the site administrator regarding the materials and the installation method. The links to the PDF presentations of the First Prize winners and the Award of Excellence winners are provided in the following:

Category A (Spatial Design)

First Prize
Kotoko Onishi, So Yo
"Fluctuation of Waves: Distanced yet Connected by the Wave Bench"

Award of Excellence
Satoshi Nagamoto, Ryo Nishimura, Miyu Iwahashi, Risa Kizaki, Kento Shu, Sae Matsushita, Hinako Yamajo, Suzu Sakamoto, Aoi Yonemitsu
"In the Right Middle of a House and an Open Field"

Award of Excellence
Akihiro Koike
"Embellishing the Place with 'places of Dancing Colors'"

Public Competition for Maintaining Social Distancing: “Staying Connected While Apart”
Category B (Technical Engineering) Evaluation Results

September 30, 2020

Category B (Technical Engineering) chief jury

Kimihiro Sakagami (Professor of the Graduate School of Engineering)

Category B (Technical Engineering)

First Prize

Kentaro Emura, Hiroaki Aoki, Kota Kirinoe, Haruka Yagyu, Kai Washino, Sotaro Nishihara, Natsumi Matsui

“Social Mile Post: Mile Post for Connecting While Distancing”

Image drawing of the submitted proposal (extracted from the submitted PDF)

Honorable Mention

No prize winner

The theme of this competition is to design a space on campus to convey the university as a space available for both experimental research activities and recreational activities for the local communities. The objective of this competition is to provide support to participants in realizing their outstanding proposals while evaluating their effectiveness. The Technical Engineering category was opened exclusively to technical, engineering proposals in the fields of mechanical/electrical/information engineering, applied chemistry, or the combination of those, in order to realize a well-developed open space that meets the social distancing requirements.

This competition was announced on July 14, 2020, and 3 proposals were submitted by the deadline on September 7, 2020. For the Technical Engineering category, a jury of 7 people

(Yoshitada Isono, Masatoshi Kitamura, Kimihiro Sakagami, Nobutaka Kuroki, Hirotaka Suzuki, Akira Takada, Yuichiro Yamabe) examined and evaluated the submitted proposals. The first round of evaluation was conducted to give 5 levels of grading from 1 to 5, from the viewpoints of design quality, compatibility with the site, originality, feasibility, and the potential for universality. The second round of evaluation was conducted in the form of online discussion in which 7 juries give critique for each proposal. Other than the proposal receiving the First Prize, there were proposals utilizing the technologies of image synthesis and AR, which some jury members highly commended for their feasibility; however, the dominant opinion among juries was that those proposals do not exhibit enough technical novelty. They also pointed out that the need to install an app on smartphones might present an obstacle for some people, and there is no significance for such proposals to be applied to this particular site on campus. On the other hand, the First Prize winner was highly praised by many juries for its technical novelty with the potential of improving the attractiveness of the site despite concerns raised regarding its safety; it also received the highest point in the 1st round of evaluation. Unfortunately, it was considered there was no Honorable Mention prize winner for this competition.

Regarding the installation of benches and poles based on the First Prize proposals, some requests were made to the winners to ensure the safe usage of the site with consideration to the cases where the site is used during holidays when the site administrator cannot keep an eye on the safety of visitors. They were requested to ensure safety by thoroughly discussing with the site administrator regarding the materials and the installation method. The links to the PDF presentations of the First Prize proposal is shown as follows:

Category B (Technical Engineering)

First Prize

Kentaro Emura, Hiroaki Aoki, Kota Kirinoe, Haruka Yagy, Kai Washino, Sotaro Nishihara, Natsumi Matsui

“Social Mile Post: Mile Post for Connecting While Distancing”

Lecture Series: "Understanding Complex Phenomena Through Graphical Representations"

Hirotaka Suzuki[1], Keiko Gion[2] and Naoto Ohmura[3]

[1]Department of Architecture, Graduate School of Engineering; and Graphics Literacy Education and Research Center
[2]V. School; Department of Civil Engineering, Graduate School of Engineering; and Graphics Literacy Education and Research Center
[3]Department of Chemical Science and Engineering, Graduate School of Engineering; and Graphics Literacy Education and Research Center

Keywords: Graphical representation, complex phenomena, visualization, Webinar

1. Introduction

The Graphics Literacy Education and Research Center (GLEC) plans to offer Graphics Literacy ABCD courses starting in academic year 2021/22, and it is necessary for the members of the center to share a wide range of knowledge and skills about graphics literacy related to various fields. Considering the fact that the GLEC is an education center, it would also be meaningful to open up its knowledge and skills to the general public beyond its members for the purpose of dissemination of knowledge and insights. For this reason, we have decided to organize a series of seminars on analyzing and explaining complex phenomena using graphical techniques and knowledge. As of February 13, 2021, at the time of this writing, two seminars have been completed and one seminar is scheduled to be held. All seminars are to be held online via Zoom, and there is no charge for participation. Information on the dates, times, speakers, and lecture titles for the first three seminars are described in following flyer pages in Japanese.

Lecture Series

Flyer

グラフィカルな表現法による複雑現象の理解

第 1 回勉強会

科学技術に関するコミュニケーションにおいて、グラフィクスは非常に強力なツールの一つです。グラフィクスは、文字や数字だけでは表現が難しい知識や概念の理解を容易にするものであり、大量のデータを扱うデータサイエンスの分野や、自然科学、人文科学、社会科学を問わず、複雑な現象を理解するために欠くことのできないものとなっています。しかし、グラフィクスの利用法や作成方法は、高等学校までの教育システムでは体系的に指導されておらず、多くの人が直感的な理解で利用しているのが現状であり、しばしば正しくコミュニケーションが取れない場合があります。社会が高度に進化し、複雑化している現代にとってグラフィクスリテラシーは非常に重要なものとなっています。

そこでグラフィクスリテラシー教育研究センターでは、勉強会「グラフィカルな表現法による複雑現象の理解」を立ち上げ、定期的に遠隔セミナーを開催し、社会の中に散在する複雑現象の理解に対するグラフィクスの有効性について議論をしていきます。第 1 回目は東京工業大学の松本秀行先生にご登壇いただき、化学プロセスにおける動的かつ複雑な現象の理解と応用のためのグラフィカルな表現法を用いたシステムズアプローチについてお話していただきます。

1. 日時：　12 月 1 日（火）17:00 ～ 18:30
2. 講演：「離散事象システムモデルを用いた化学プロセス・ダイナミクスの表現」
3. 講演者：松本秀行先生（東京工業大学物質理工学院応用化学系　准教授）
4. 参加費：無料
5. Zoom URL: 申込された方に直接お知らせいたします。

申込：問い合わせ先に、メール(タイトルは「第 1 回勉強会」として下さい)で、お名前、ご所属、メールアドレスをお送り下さい。

問い合わせ先：eng-glec@research.kobe-u.ac.jp

主催：神戸大学大学院工学研究科グラフィックスリテラシー教育研究センター

共催：（公社）化学工学会 SIS 部会ダイナミックプロセス応用分科会

日本図学会関西支部

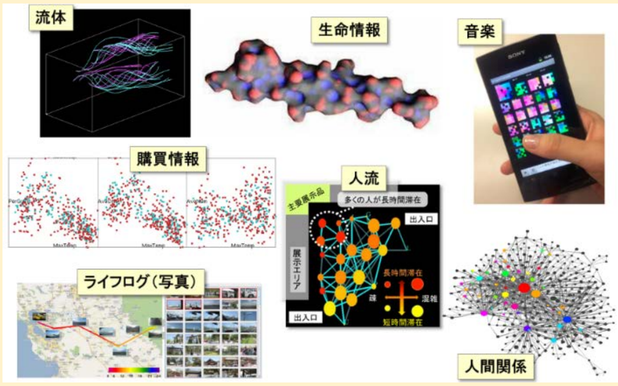
Lecture Series

Flyer

グラフィカルな表現法による複雑現象の理解

連続セミナー 第２回

科学技術に関するコミュニケーションにおいて、グラフィクスは非常に強力なツールの一つです。グラフィクスは、文字や数字だけでは表現が難しい知識や概念の理解を容易にするものであり、さまざまな分野において複雑な現象を理解するために欠くことのできないものとなっています。グラフィクスリテラシー教育研究センターでは、勉強会「グラフィカルな表現法による複雑現象の理解」を立ち上げ、定期的に遠隔セミナーを開催し、社会の中に散在する複雑現象の理解に対するグラフィクスの有効性について議論をしています。第2回セミナーではお茶の水女子大学の伊藤貴之先生にご登壇いただき、自然・応用科学、社会・人文科学等幅広い分野における情報可視化による複雑現象表現のアプローチについてお話していただきます。



1. 日時：　2021年1月25日（月）18:00 ～ 19:30
2. 講演：　「情報可視化による複雑現象の表現」
3. 講演者：伊藤貴之先生（お茶の水女子大学文理融合AI・データサイエンスセンター　センター長）
4. 参加費：無料
5. Zoom URL: 申込された方に直接お知らせいたします。

申込：問い合わせ先に、メール(タイトルは「第 2 回勉強会」として下さい)で、お名前、ご所属、メールアドレスをお送り下さい。

問い合わせ先：eng-glec@research.kobe-u.ac.jp

主催：神戸大学大学院工学研究科グラフィックスリテラシー教育研究センター
共催：お茶の水女子大学文理融合AI・データサイエンスセンター
日本図学会関西支部
神戸大学数理・データサイエンスセンター
神戸大学 V.School
協賛　（公社）化学工学会SIS部会ダイナミックプロセス応用分科会

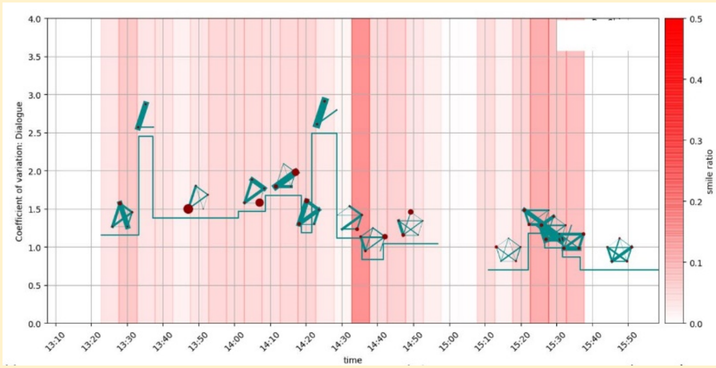
Lecture Series

Flyer

グラフィカルな表現法による複雑現象の理解

連続セミナー 第3回

科学技術に関するコミュニケーションにおいて、グラフィクスは非常に強力なツールの一つです。グラフィクスは、文字や数字だけでは表現が難しい知識や概念の理解を容易にするものであり、さまざまな分野において複雑な現象を理解するために欠くことのできないものとなっています。グラフィクスリテラシー教育研究センターでは、勉強会「グラフィカルな表現法による複雑現象の理解」を立ち上げ、定期的に遠隔セミナーを開催し、社会の中に散在する複雑現象の理解に対するグラフィクスの有効性について議論をしています。第3回セミナーでは、i.school エグゼクティブディレクターで(一社)日本社会イノベーションセンター(JSIC)代表理事も務められている堀井秀之先生にご登壇いただき、チームワークの可視化による複雑現象表現のアプローチについてお話していただきます。



1. 日時　：2021年2月18日(木) 18:00 ～ 19:30
2. 講演　：「i.school のイノベーションワークショップにおけるチームワークの可視化」
3. 講演者：堀井秀之先生（i.school・エグゼクティブディレクター／(一社)日本社会イノベーションセンター(JSIC)・代表理事／東京大学・名誉教授）
4. 参加費：無料
5. Zoom URL: 申込された方に直接お知らせいたします。

申込：問い合わせ先に、メール(タイトルは「第 3 回勉強会」として下さい)で、お名前、ご所属、メールアドレスをお送り下さい。

問い合わせ先：eng-glec@research.kobe-u.ac.jp

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共催：(一社) 日本社会イノベーションセンター(JSIC)
イノベーション教育学会
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協賛：(公社) 化学工学会 SIS 部会ダイナミックプロセス応用分科会

Educational Content to be Provided in Graphics Literacy A: Technologies for surveying shapes by using drones

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Keywords: drone, survey, flight principles, 3D analysis, laws

1. Introduction

In Graphics Literacy A, students will learn basic knowledge of drones, principles and procedures of drone surveying, examples of drone applications in various fields, trends of drones in Japan, and future prospects. This article provides a detailed explanation of the course contents.

2. Technologies for surveying shapes by using drones

Graphics Literacy A consists of three sessions about technologies for surveying shapes by using drones. The schedule and contents are shown in Table 1.

Table 1. Schedule and contents of three sessions about technologies for surveying shapes by using drones

	Theme	Contents
1st session	Basic knowledge of drones	• What are drones • Drone structure and flight principles • Various laws and regulations related to drones
2nd session	Principles and methodologies of drone surveying	• 3D analysis and its principles • Differences from conventional methods • Photogrammetry and laser surveying • Analysis examples
3rd session	Applications in various fields and future trends	• Introduction of application fields related to measuring with drones • Latest legal amendments and future prospects

The first session provides basic knowledge of drones: the origin of the name “drone,” drone structure and flight principles (see Fig. 1), and laws and regulations related to drones. Using DJI Phantom 4 Pro (see Fig. 2), which has a high market share, for demonstration, students will observe how the propellers rotate.

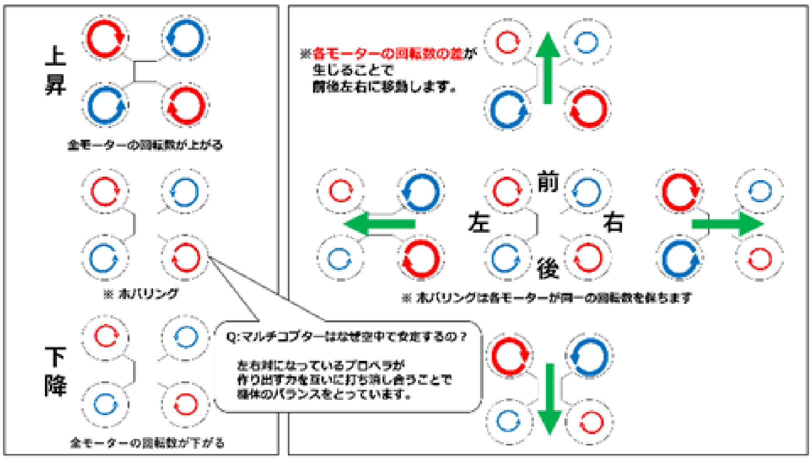

Fig. 1. Correspondence between propeller rotation and flight conditions

Fig. 2. DJI Phantom 4 Pro

The second session is about 3D analysis, which is the most important technology in drone surveying. Its principles and methodologies are learned through performing analysis using Agsoft’s MetaShape analytical software (see Fig. 3).

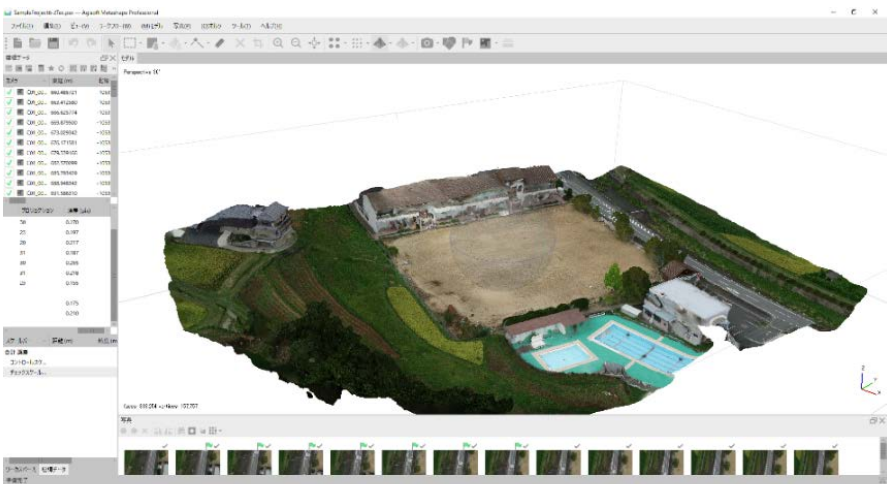

Fig. 3. Example of 3D analysis using data obtained by drones

In the third session, application examples in different fields will be introduced, focusing on measuring with drones used for purposes other than surveying. Examples include measurement of deterioration during structural inspections (see Fig. 4). Examples using special cameras (see Fig. 5) and drones for industrial uses will also be introduced.

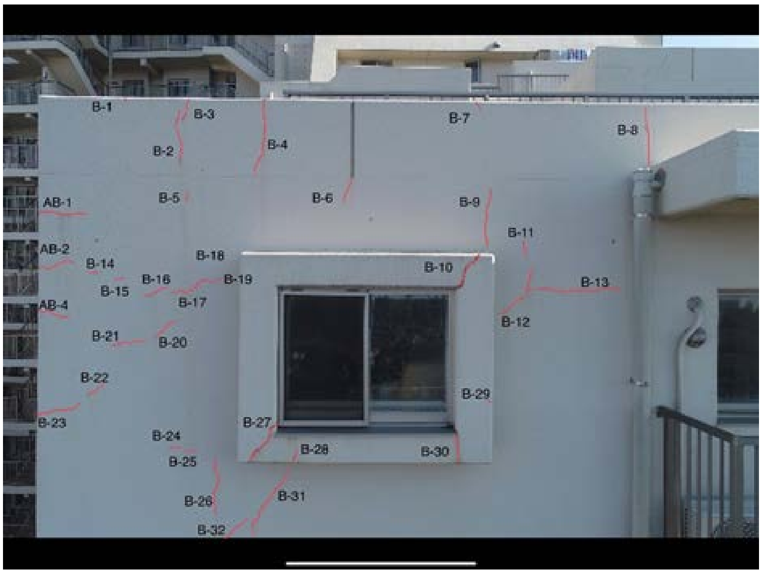

Fig. 4. Example of condominium wall crack inspection

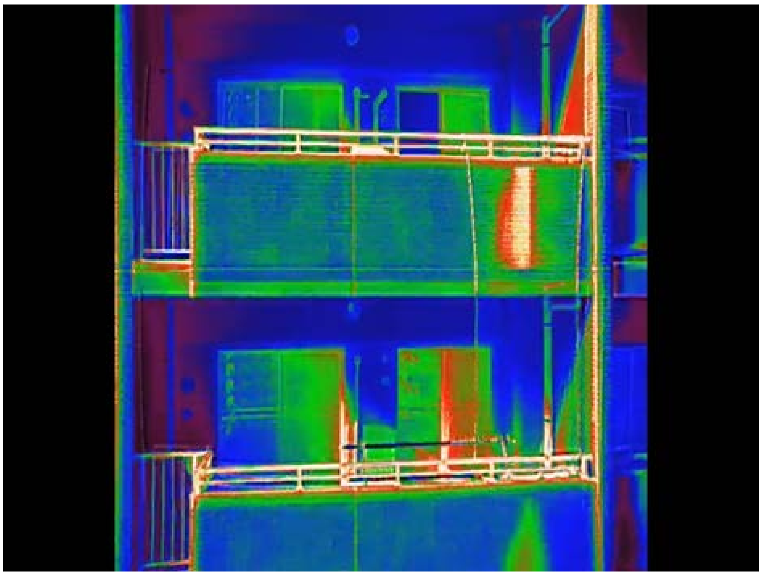

Fig. 5. Application using infrared camera images

At the end of the third session, the changes in the circumstances around drones and the future outlook will be discussed, using the 2020 Roadmap for Aerial Industrial Revolution (see Fig. 6) developed by a public-private council for improving the environment for small unmanned aerial vehicles.

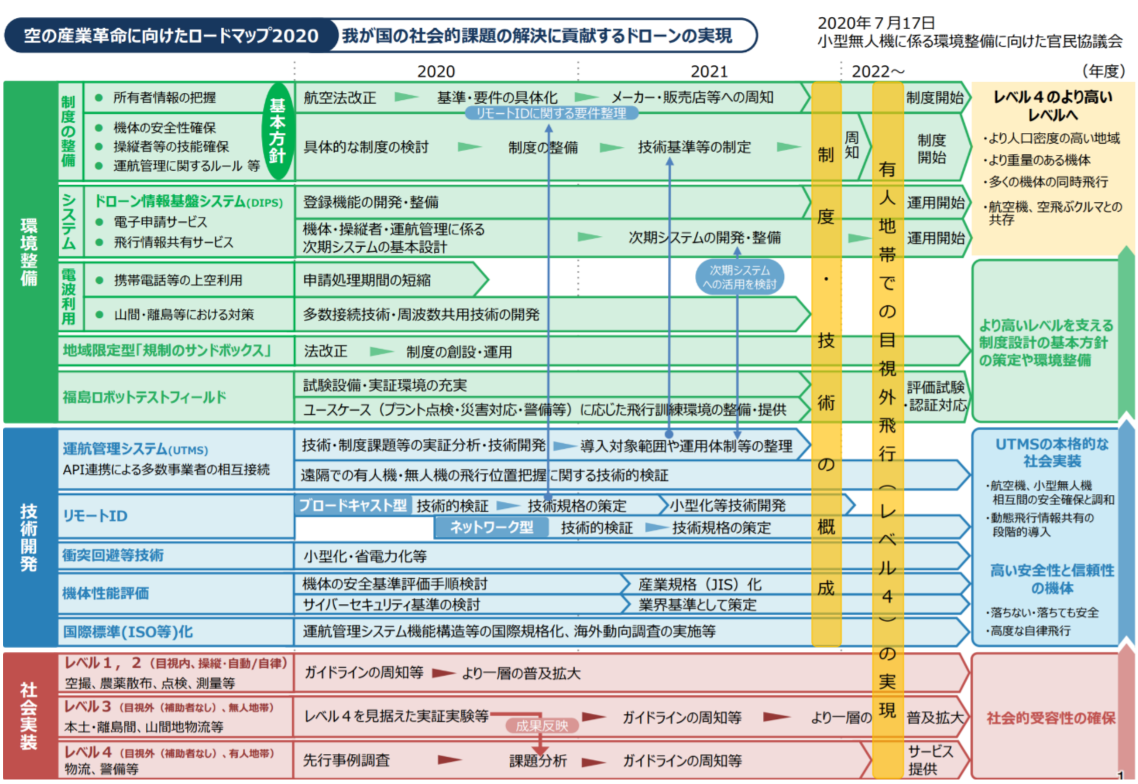

Fig. 6. 2020 Roadmap for Aerial Industrial Revolution

(Source: https://www.kantei.go.jp/jp/singi/kogatamujinki/pdf/siryou14.pdf)

Educational Content to be Provided in Graphics Literacy A: Technologies for surveying shapes and making shapes

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Keywords: 3D scanners, photogrammetry, 3D printers, additive manufacturing

1. Introduction

With 3D scanners and 3D printers, methods employed in the manufacturing industry have become more diverse. The utilization of these new devices has enabled products with more flexible designs, which would have been impossible with conventional manufacturing methods.

Focusing mainly on industrial products, this course will provide an overview of recent technologies for surveying and fabrication. The schedule and contents are shown in Table 1.

Table 1. Schedule and contents of three sessions about technologies for surveying and fabrication

	Theme	Contents
1st session	Technologies for surveying shapes	• 3D scanners • Photogrammetry
2nd session	Technologies for fabrication	• 3D printers • Materials
3rd session	Examples of shape-related technology uses	• Reverse engineering • Structure recognition • Generative design

2. Course Description

2. 1 Technologies for surveying shapes

Conventionally, direct contact to 3D objects with a measuring tool or instrument has been required to obtain information about their shapes and dimensions. In contrast, non-contact 3D scanners and photogrammetry enable contactless measurements of objects. The non-contact 3D scanners can be roughly categorized into two groups: laser triangulation and structured light. Their operating conditions are different, but the scanning operation is mostly similar. Fig. 1 shows a 3D scanned example using an infrared camera.

Photogrammetry is often used for relatively large objects. 3D data can be obtained by using photo data and a software application without any physical devices.

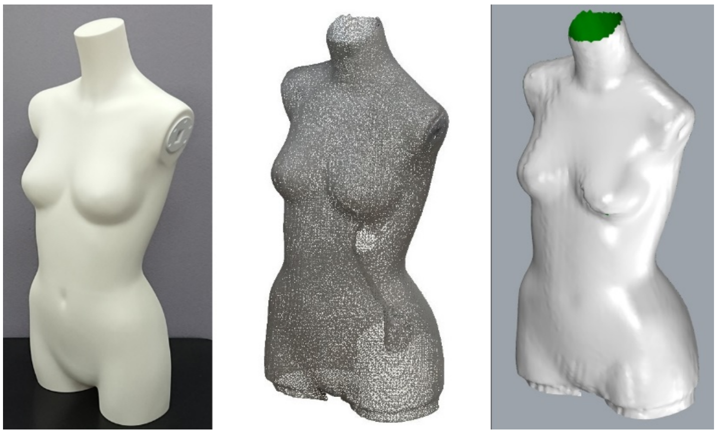

Fig.1. Original item (left), scanned mesh data (center) and shaded view by 3D CAD (right)

2. 2 Technologies for making shapes

The process of layering materials into a shape is called Additive Manufacturing, and its representative example is 3D printing. Various types of 3D printers, including Fused Deposition Modeling (FDM), are available. The device and materials are selected according to the purpose and design of the final object.

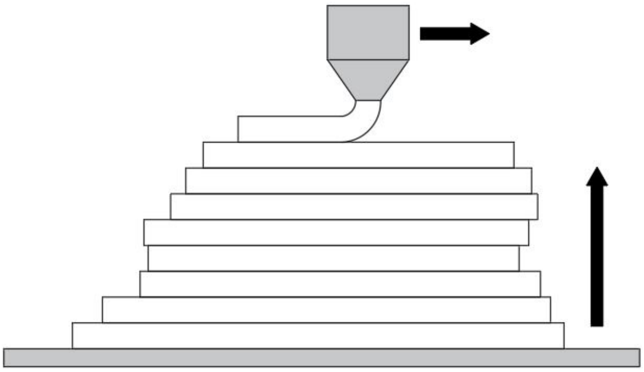

Fig. 2. FDM 3D printing

Preparation of proper 3D data is required for 3D printing. Data obtained by 3D scanning is insufficient for 3D printing (although with slight adjustments, such data can be used for virtual spaces or for dimension checking purposes), and therefore proper modifications are necessary using 3D CAD. Fig. 3 shows an example of a model printed by FDM.

Fig. 3. Model printed by FDM

2. 3 Examples

3D scanning is sometimes used during new product development to capture design information from commercial products, previous products, etc. In some cases, the shapes of manually produced clay models (design modeling using clay) are scanned for use in a specific design, and these methods are called reverse engineering.

For repairing or remodeling an old structure with no available design drawings, a construction plan is made by capturing its shape using 3D scanners and photogrammetry in advance. Fig. 4 shows the 3D shape of a building captured by photogrammetry and reproduced by CG.

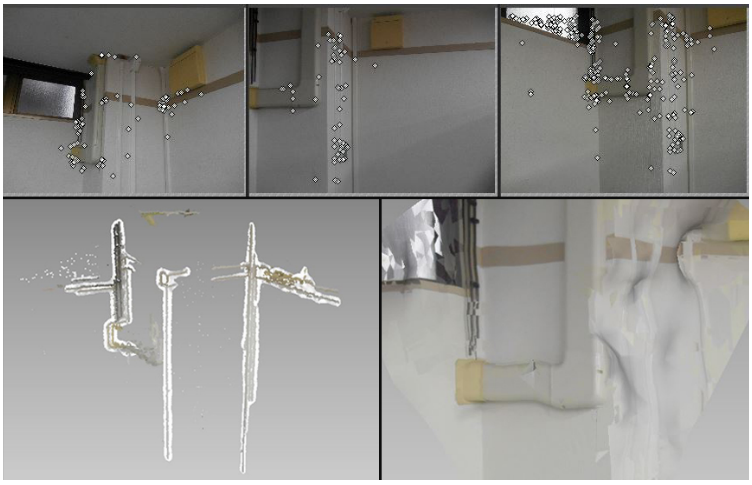

Fig. 4. Photogrammetry working screen

In cutting processes, limited designs of parts can be processed due to the limited operating range of the tools, whereas 3D printing utilizing additive manufacturing can materialize arbitrary designs. X-ray CT can visualize not only the external shape but also provide three-dimensional images of the inside of the human body by using software and therefore finds application in the medical field.

3. Conclusion

3D scanners have been integrated into drones, and their uses are expanding in the construction and civil engineering fields. 3D printing used to be mainly used for prototyping, but as the usable materials have increased, including metals and heat-resistant materials, it is expected to be used directly for final product manufacturing and mass production using resin molds.

It broadens the range of industrial design by enabling the materialization of organic designs, as shown in Fig. 5.

Fig. 5. Organic design using 3D CAD

In addition, generative design (a method in which a computer suggests design options for parts) cannot be applied to designs that involve cutting, but it may be an effective design method in the future for designs that would be 3D printed.

Educational Content to be Provided in Graphics Literacy D: Techniques for Drawing Figures and Diagrams in Computer Graphics (CG)

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Keywords: Computer graphics, POV-Ray, Ray tracing, Visualization, Animation

1. Introduction

In Graphics Literacy D, students learn how to draw figures and diagrams using computer graphics (CG) by actually operating a PC. They also learn how to visualize and create animations, which will be useful for later research activities and presentations. In this paper, we will illustrate the content of this course.

2. Graphics Literacy D Course Contents

Table 1 shows the week-by-week contents provided in Graphics Literacy D.

Table 1. Schedule and contents of Graphics Literacy D

Week	Contents	Exercises
1st session	Introduction and Installation	• After installation, render a scene file and check its operation
2nd session	How to render and describe objects	• Simple scene file manipulation and scarecrow assembly
3rd session	Object manipulation and repetition	• Creating a spiral staircase by rotating, scaling, translating, and repeating basic objects
4th session	Conditional branching and set operations, texture, and light handling	• Repeated placement of spheres and coloring, creation of a teapot-like shape, creation of a cross-sectional view, repetition and set operations, use of texture
5th session	Use of groups, random numbers, stereoscopic view, etc.	• Creating scenes that use groups, creating scenes that don't drop shadows on the guide map, creating scenes with random snowfall
6th session	Representation of geometrically defined surfaces	• Plane curves, space curves, and surfaces
7th session	Animation	• Moving basic objects, rotating basic objects, animating any scene file

POV-Ray, a free ray tracing software, was used as the CG tool because it is a free, multi-platform that supports UNIX and MS-DOS as well as Windows and Mac, and can correctly express the texture of materials (ray tracing is used in the rendering algorithm, so it can handle the positive reflection of mirrors and the positive transmission of glass). As shown in Fig. 1, POV-Ray is a script description type of modeler, not a so-called WYSIWYG (What You See Is What You Get) type, nor a GUI type that allows intuitive manipulation of figures using a mouse.

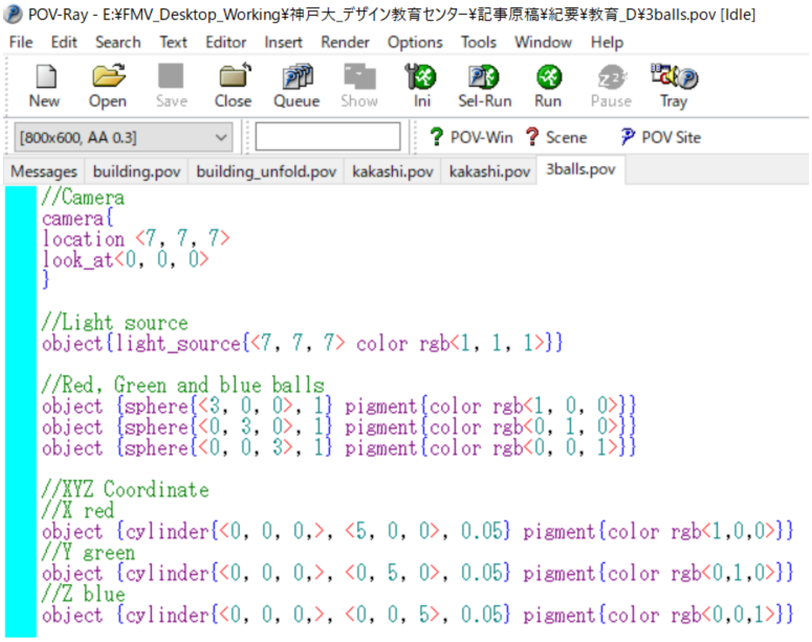

Fig. 1. Example of data description in POV-Ray.

As for the use of modelers in general design activities, the WYSIWYG and GUI types are often considered to be more suitable. But in cases such as the visualization of numerical calculation results, the script description type is more suitable, and this is the fourth reason why POV-Ray is used.

In the 2019/20 academic year, we conducted a two-session training in computer graphics on a trial basis under the subject of Graphic Science Exercise 1 (offered in the third quarter (Q3) term at the Department of Architecture and Civil Engineering), and examined whether it was possible to use POV-Ray on the required computers (Windows or Mac). During the training, it became clear that it did not work on Mac depending on the version. Therefore, in the 2020/21 academic year, after gathering more extensive information about POV-Ray running on Mac, we are providing the contents of Table 1 in advance in Graphic Science Exercise 2 (offered in the fourth quarter (Q4) term at the Department of Architecture and Civil Engineering). Under the COVID-19 crisis, we started with online classes to explain the operation of POV-Ray on a PC, but we managed to finish the Graphic Science Exercise 2 without encountering any problems. In the future, we will decide on the content of Graphics Literacy D after making some selections, and this paper will report on the course contents of Graphics Literacy 2 in the 2020/21 academic year.

As shown in Table 1, Week 1 is introduction and installation, and the subsequent Weeks 2 through 5 are not much different from the content of computer graphics training in the so-called information processing field. However, as shown in Fig. 1, the data description is text-based and difficult to understand intuitively. Therefore, as shown in Fig. 2, we handed out sample data (called scene files in POV-Ray) to students in advance so that they could learn the description method by modifying the data.

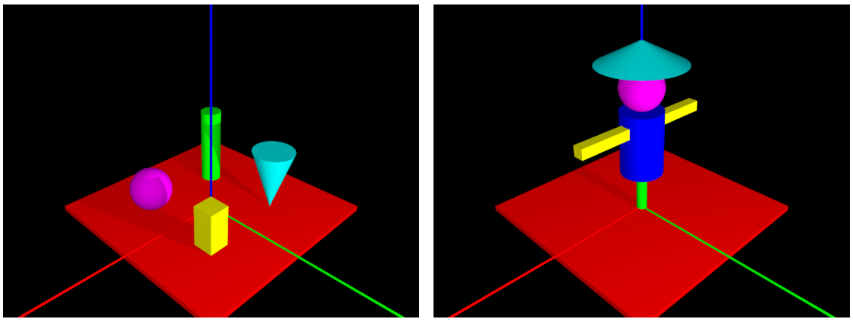

Fig. 2. Rendering of the distributed state (left) and the completed scarecrow.

In explaining repetition in Week 3, a spiral staircase is used to illustrate the correspondence between the parameters of repetition and the start position, end position, and tread spacing. As shown in Fig. 3, we demonstrated that the treads can be made continuous to form a slope by making the number of steps far less. We then associated this with the geometrically defined curve, which was scheduled to be explained in Week 6.

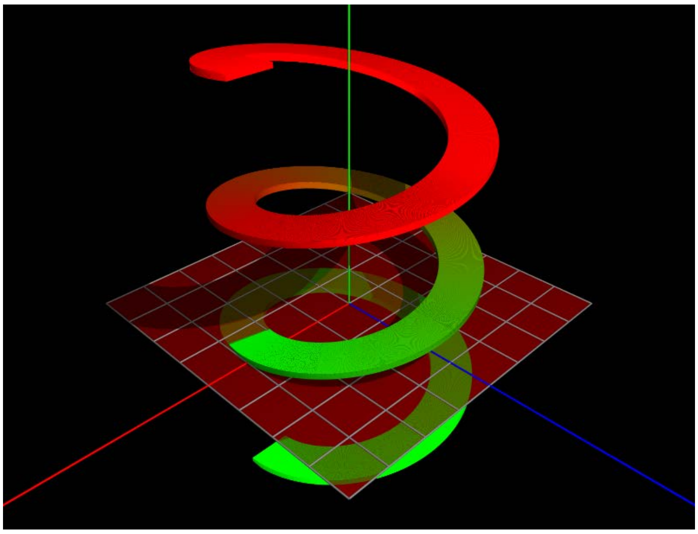

Fig. 3 A spiral staircase rendered as a slope with a smaller number of steps.

In addition, in Week 4, the students were tasked with creating a cross-sectional view with set operations by expanding from a scene file that creates a shape like a teapot using set operations (see Fig. 4). This task is designed to help them acquire the ability to describe shapes in various ways.

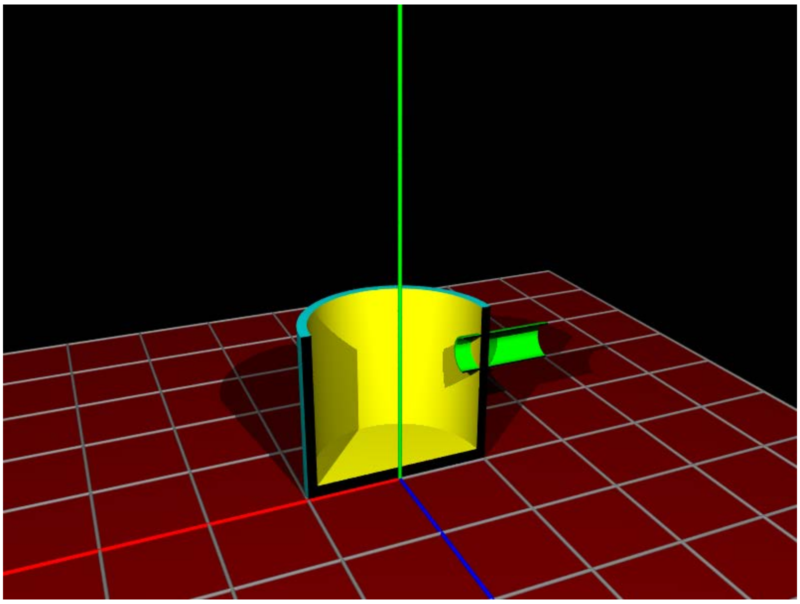

Fig. 4. Example of a cross-sectional view of a teapot-like shape.

Moreover, in the fourth week of this course, the students were asked to apply the teapot-shaped scene file to create a shade using a shape with repetitive holes (see Fig. 5), and explain how to handle texture and light (see Fig. 6). For their first assignment, we assigned them to create a lighting fixture in the form of a scene file using set operations, which was due the week after.

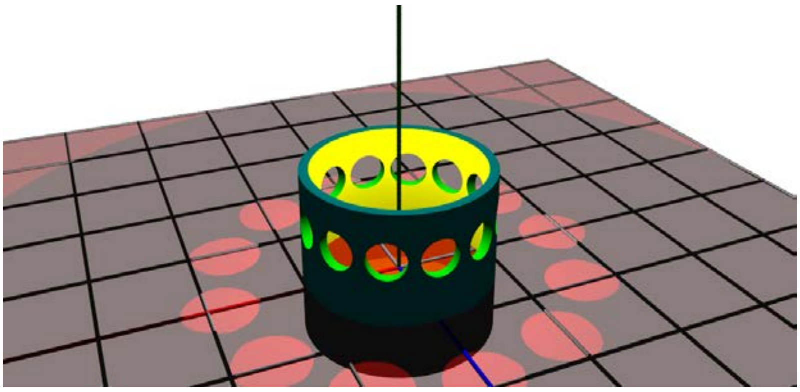

Fig. 5. Example of shading using a form with repetitive holes.

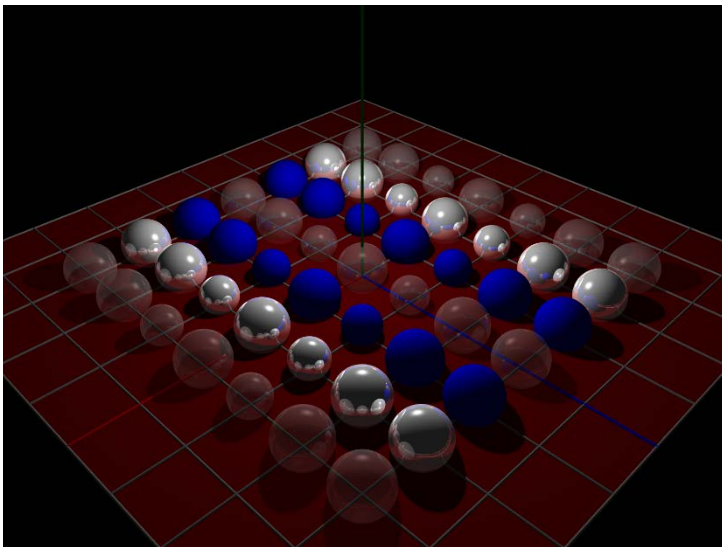

Fig. 6. Example of mapping various textures to illustrate surface reflections.

In Week 5, we explained the use of groups, random numbers, stereoscopic view, and others. In general, photorealism tends to be preferred in computer graphics. For example, in the case of a diagram like in Fig. 7, which shows the center coordinates of a sphere object, the auxiliary lines, coordinate axes, and grid in this diagram are entities that have a different meaning from the sphere, and we must avoid making diagrams where these cast a shadow on the sphere.

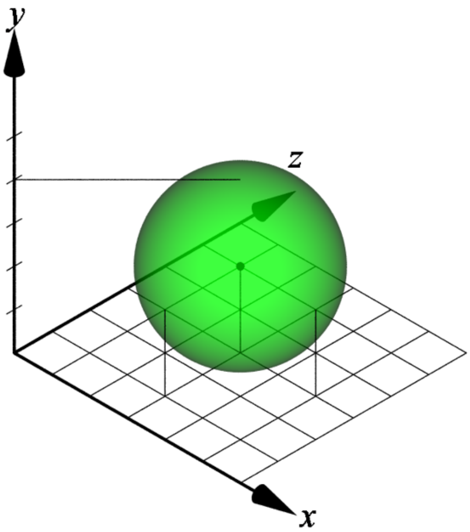

Fig. 7. Diagram showing center coordinates of a sphere object.

In addition, compared to parallel projections, which are suitable for conveying quantitative information such as length, angle, and shape, perspective projections are suitable for conveying qualitative information such as formal elements of objects that affect the objects' impression. In the case of conveying information such as that shown in Fig. 7, parallel projections are more appropriate, and perspective projections should be avoided. Some of the "other" contents to be covered in this week include important contents related to literacy in drawing, such as how to set up a scene without dropping shadows and how to make it a parallel projection. In addition, in the explanation of using a scene file to generate snow with random numbers, the students were given an assignment to develop it further and generate a random number limited within a certain range, as shown in Fig. 8, which is related to the contents from Week 6.

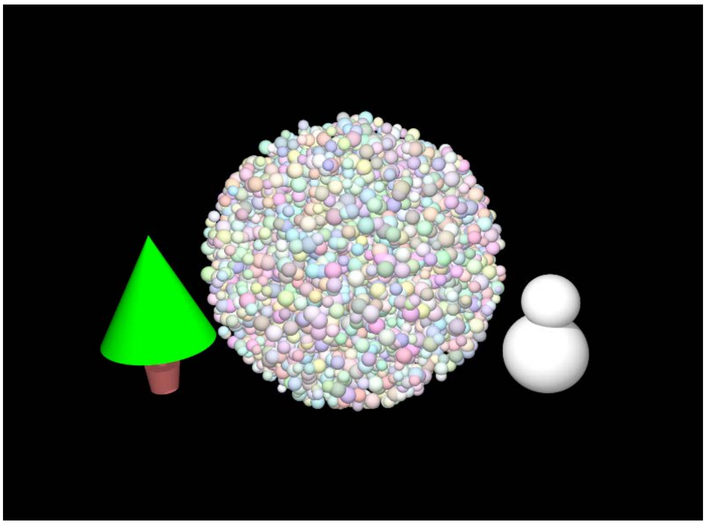

Fig. 8 Example of many snowflakes in a sphere.

In terms of content, Week 6 is the most characteristic of this course, dealing with plane curves (see Fig. 9), space curves (see Fig. 10), and surfaces (see Fig. 11) defined by mathematical expressions.

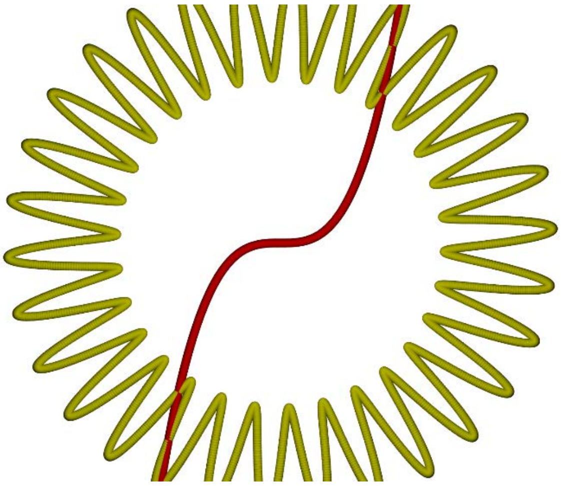

Fig. 9. Example of a plane curve (a curve made with a trigonometric function changing the radius of a circle, and a cubic curve).

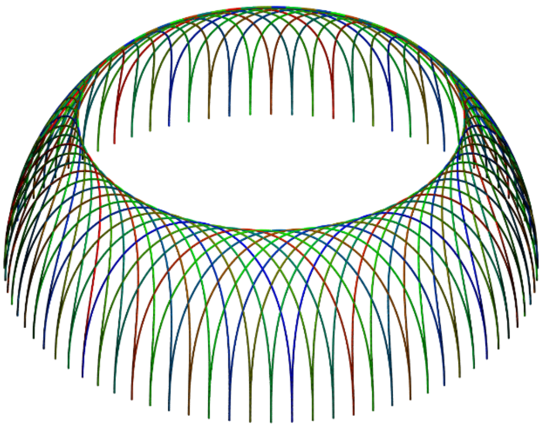

Fig. 10. Example of a space curve (an adjoining cycloid developed in a hemisphere).

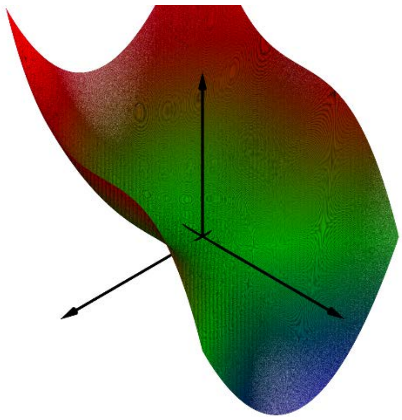

Fig. 11 Example of a surface (Mathematical surface given by z = x^2 - z^3).

In these cases, the mathematical formulae that define the curves and surfaces are often given in the form of functions such as $y = f(x)$ or $z = f(x, y)$ in the distributed scene files, and students can draw different curves and surfaces by simply changing the contents of the functional equations. After changing the contents of the functional equations and confirming the shape, they can be applied to change the fineness of the curve drawing and also change the color as shown in Fig. 10. In fact, POV-Ray has its own file I/O function and can refer to external files by writing I/O-related descriptions in the scene file. For this reason, it is possible to refer to external files for numerical calculation results and visualize them accordingly. However, due to the time constraint, we have not explained that much.

Week 7 centers on the theme of animation. In POV-Ray, a variable called clock, which takes a continuous value from 0 to 1, is used to render a changing still image. The range of the change in clock depends on the amount of still images to be generated, and if n is a positive integer, then clock will change from 0 to 1 in 1/(n-1) steps. In many computer graphics tools, the position and direction of the camera can be changed using keyframes, etc. However, in POV-Ray, all changes are expressed by relating them to the clock. The scene files handed out to the students are only related to the movement of the basic object and the rotation of the basic object (see Fig. 12), but by connecting the clock to the brightness of the light source, and to the camera position, it is possible to create animations that gradually become darker or move the camera further away from objects.

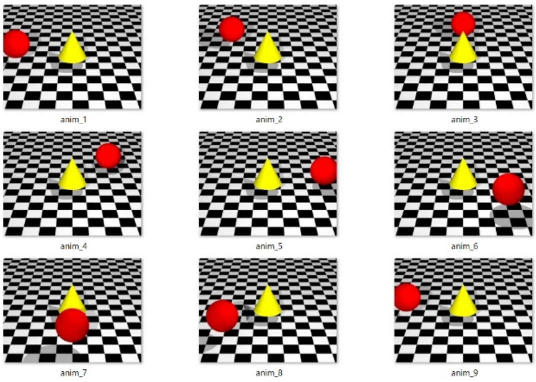

Fig. 12. Example of rendering a scene file that rotates a basic object and outputs 9 still images.

We then asked the students to select a scene file that they have created so far, and explained how to rotate all or some of the objects in the file (using set sum) and how to change the brightness and darkness by changing the position of the light source. In illustrating these techniques, we used the shape shown in Fig. 5 to rotate the shape of the shade on the stand and move the positions of the two light sources, yellow and blue, up and down separately, so that the light that passed through the holes create bright ellipse-like areas on the horizontal plane. This allowed the ellipse-like illuminated areas to move away and closer to the center as they rotated, while changing their color by the mixing of yellow- and blue-colored lights in varying proportions (see Fig. 13).

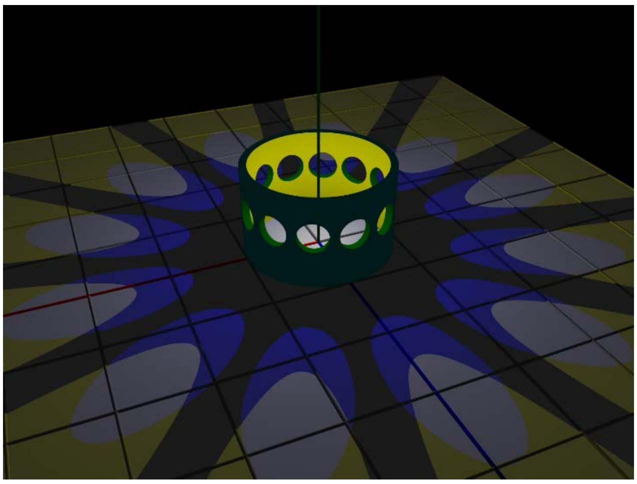

Fig. 13 Example of animation.

Due to the time and platform constraints, we only explained how to create the changing still images in the class, and checked how these images move, frame by frame, by switching them with the arrow keys. For the final conversion to a single video file (avi file, wmv file, etc.), we decided to refer to the book we adopted as a textbook[1).].

Before the end of the class in Week 7, we assigned the students to create a "scene with a unique shape" as their final task. In order to make the students as enthusiastic as possible, we decided that the theme should be "something that each of us is attached to" or "something useful.

3. Conclusion

This report introduced the contents of Graphics Literacy D by illustrating the contents of Graphic Science Exercise 2, the contents of which were changed this year. There are two assignments to be submitted: modelling a lighting fixture and a final project. Since the grading period is still in progress at the time of writing, we have not yet been able to confirm the kinds of works that have been submitted. However, we hope to improve the quality of submissions year by year by posting them online, with personal information removed.

References

1) Hirotaka Suzuki, Kazuo Kurata and Hisashi Sato, “3D-Computer Graphics Creation with POV-Ray,” (CG-ARTS) (2008).