Research Paper

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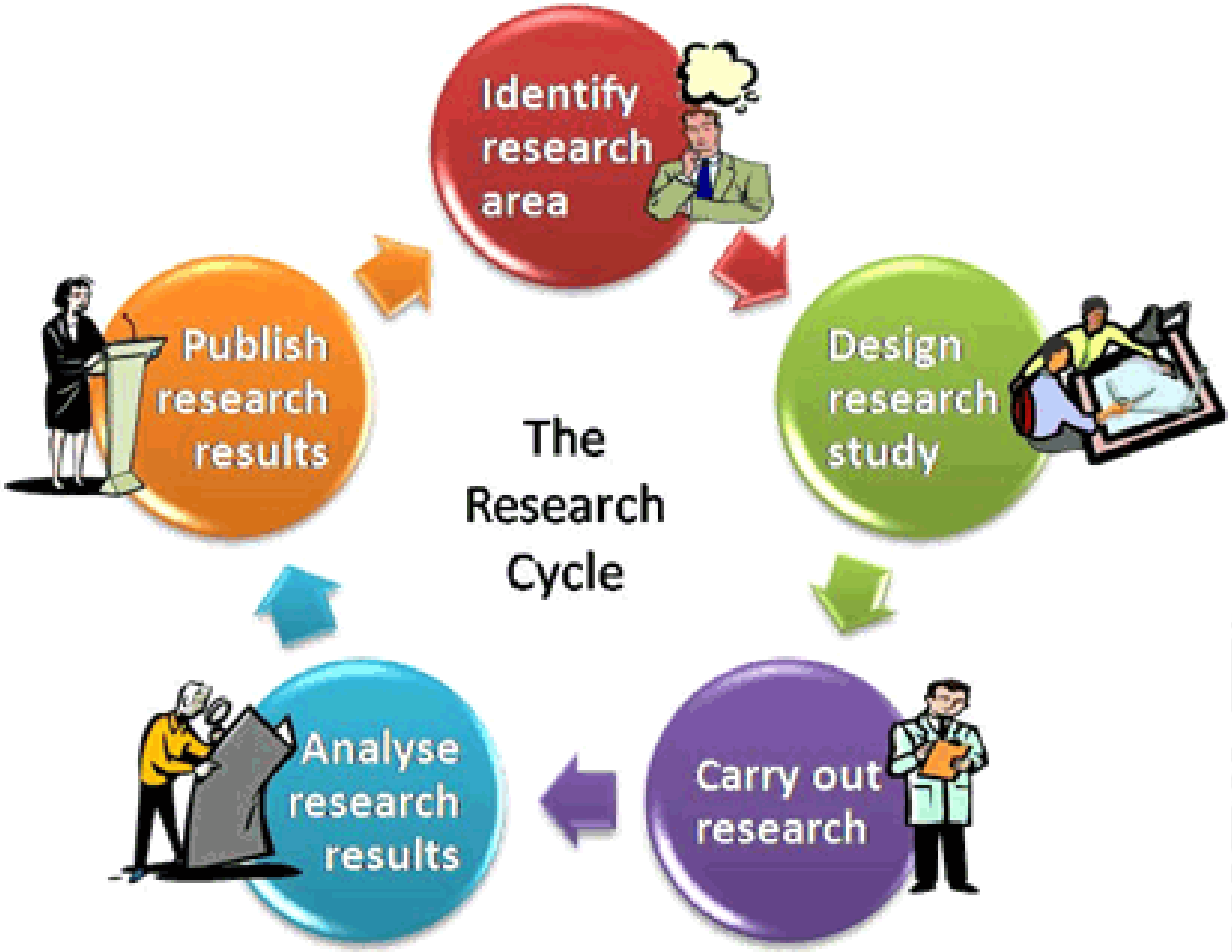
Research

- Research is defined as the creation of new knowledge and/or the use of existing knowledge in a new and creative way so as to generate new concepts, methodologies and understandings.

Steps in conducting research

- Identification of research problem
- Literature review
- Specifying the purpose of research
- Determine specific research questions or hypotheses
- Data collection
- Analyzing and interpreting the data
- Reporting and evaluating research

Research cycle



How to Identify Research Problem?

Read, Read and Read!

Writing

Structure of Research Paper

- Title
- Abstract
- Introduction
- Related Work
- Problem Formulation
- Experimental/Methodology Section
- Results and Discussion
- Conclusions
- Acknowledgments
- References
- Supporting Information/ appendices

Research Paper-I

Title

As you craft a name for your paper, you should consider these potential objectives for the title you choose.

A title should:

- Describe the content of the paper
- Distinguish the paper from others on a similar topic
- Catch the reader's attention and interest
- Match search queries so people will find your paper (and cite it)

Research Paper-II

Abstract

$150 - 250$ words

Comprises of four parts

- Introduction/motivation/application
- Method
- Results
- Conclusion

Title

FedRSU: Federated Learning for Scene Flow Estimation on Roadside Units

Shaoheng Fang†, Rui Ye†, Wenhao Wang†, Zuhong Liu, Yuxiao Wang, Yafei Wang *Member*, Siheng Chen *Senior Member*, Yanfeng Wang

What? introduction

Why? Motivation/gap

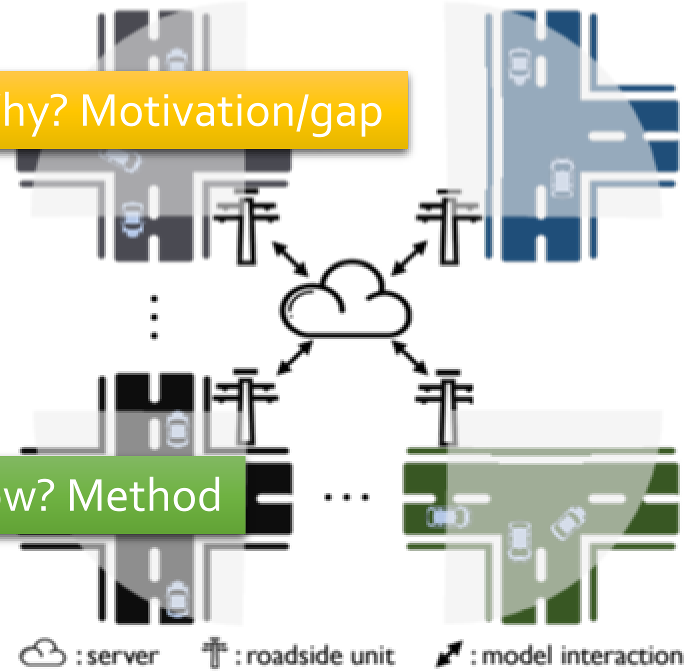
How? Method

Results

Conclusion

***Abstract*—Roadside unit (RSU) can significantly improve the safety and robustness of autonomous vehicles through Vehicle-to-Everything (V2X) communication. Currently, the usage of a single RSU mainly focuses on real-time inference and V2X collaboration, while neglecting the potential value of the high-quality data collected by RSU sensors. Integrating the vast amounts of data from numerous RSUs can provide a rich source of data for model training. However, the absence of ground truth annotations and the difficulty of transmitting enormous volumes of data are two inevitable barriers to fully exploiting this hidden value. In this paper, we introduce FedRSU, an innovative federated learning framework for self-supervised scene flow estimation. In FedRSU, we present a recurrent self-supervision training paradigm, where for each RSU, the scene flow prediction of points at every timestamp can be supervised by its subsequent future multi-modality observation. Another key component of FedRSU is federated learning, where multiple devices collaboratively train an ML model while keeping the training data local and private. With the power of the recurrent self-supervised learning paradigm, FL is able to leverage innumerable underutilized data from RSU. To verify the FedRSU framework, we construct a large-scale multi-modality dataset RSU-SF. The dataset consists of 17 RSU clients, covering various scenarios, modalities, and sensor settings. Based on RSU-SF, we show that FedRSU can greatly improve model performance in ITS and provide a comprehensive benchmark under diverse FL scenarios. To the best of our knowledge, we provide the first real-world LiDAR-camera multi-modal dataset and benchmark for the FL community.**

***Index Terms*—Roadside unit, scene flow estimation, federated learning, self-supervised learning.**



...U system overview, where multiple roadside units (RSUs) ...rain a scene flow estimation model without transmitting raw data under the coordination of a cloud server. Iteratively, each RSU trains a local model in a self-supervised manner, and the server aggregates local ...ificantly alleviate the challenges of tedious labeling ...single RSU.

arxiv.org/pdf/2401.12862.pdf

Research Paper-III

Don't use abbreviations or citations in the abstract. It should be able to stand alone without any footnotes.

Key words

- Use to search a paper
- Editor might use it to find reviewers
- Should be a part of abstract/title

***Index Terms*—Roadside unit, scene flow estimation, federated learning, self-supervised learning.**

Research paper -IV

Introduction

Introduction of a paper comprises of following

- Motivation
- Application
- What, why and how you are doing?
- List of contribution/objective
- Paper organization

What and why?

NOTE: Paragraphs should be linked/there should have continuity.

Research paper

- Contribution

potential for further improvement of FedRSU in tandem with ongoing advancements in both the fields of self-supervised scene flow learning and federated learning.

Overall, the key contributions of this work are as follows:

- We propose a new and practical federated learning framework on roadside units (FedRSU), where multiple RSUs collaboratively train a scene flow estimation model in a self-supervised manner.
- We propose a novel multi-modal scene flow learning method on each RSU client, which leverages image data to guide scene flow learning.
- We construct a diverse and practical scene flow dataset RSU-SF to promote the development of FedRSU and FL.
- We conduct extensive experiments on multiple baselines and scenarios to provide more insights and call for more future explorations.

- Paper organization/ outline

Outline. This paper is structured as follows: In section II, we introduce related works. In Section III, we formulate the proposed setting, introduce the FedRSU framework, and our proposed federated multi-modal self-supervised learning algorithm. In Section IV, we introduce the constructed dataset RSU-SF for scene flow estimation and federated learning. In Section V, we conduct extensive experiments on diverse baselines and scenarios. In Section VI, we provide discussions on future directions and limitations. In Section VII, we summarize the paper.

FedRSU: Federated Learning for Scene Flow Estimation on Roadside Units

Shaoheng Fang[†], Rui Ye[†], Wenhao Wang[†], Zuhong Liu, Yuxiao Wang, Yafei Wang *Member*, Siheng Chen *Senior Member*, Yanfeng Wang

Introductory diagram

Abstract—Roadside unit (RSU) can significantly improve the safety and robustness of autonomous vehicles through Vehicle-to-Everything (V2X) communication. Currently, the usage of a single RSU mainly focuses on real-time inference and V2X collaboration, while neglecting the potential value of the high-quality data collected by RSU sensors. Integrating the vast amounts of data from numerous RSUs can provide a rich source of data for model training. However, the absence of ground truth annotations and the difficulty of transmitting enormous volumes of data are two inevitable barriers to fully exploiting this hidden value. In this paper, we introduce FedRSU, an innovative federated learning framework for self-supervised scene flow estimation. In FedRSU, we present a recurrent self-supervision training paradigm, where for each RSU, the scene flow prediction of points at every timestamp can be supervised by its subsequent future multi-modality observation. Another key component of FedRSU is federated learning, where multiple devices collaboratively train an ML model while keeping the training data local and private. With the power of the recurrent self-supervised learning paradigm, FL is able to leverage innumerable underutilized data from RSU. To verify the FedRSU framework, we construct a large-scale multi-modality dataset RSU-SF. The dataset consists of 17 RSU clients, covering various scenarios, modalities, and sensor settings. Based on RSU-SF, we show that FedRSU can greatly improve model performance in ITS and provide a comprehensive benchmark under diverse FL scenarios. To the best of our knowledge, we provide the first real-world LiDAR-camera multi-modal dataset and benchmark for the FL community.

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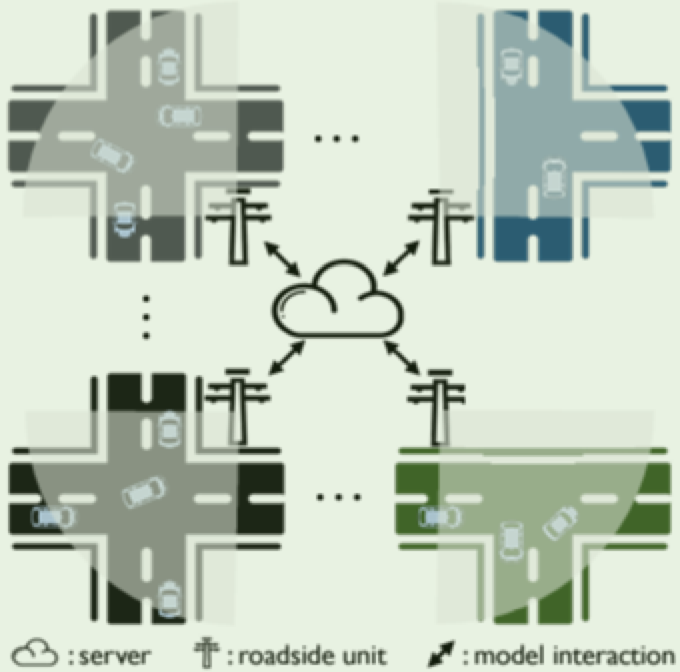

Fig. 1. FedRSU system overview, where multiple roadside units (RSUs) collaboratively train a scene flow estimation model without transmitting raw data under the coordination of a cloud server. Iteratively, each RSU trains a local model in a self-supervised manner, and the server aggregates local models. FedRSU can significantly alleviate the challenges of tedious labeling and limited data for one single RSU.

Caption

[…]o offer significant added value for intelligent autonomous

Research paper -V

Which, when, where

Related work/literature review

- How to find papers? Which papers should be prefer to cite in a paper?

- How to read reference? How audience/readers' see the reference?

[1] A. Behl, D. Paschalidou, S. Donné, and A. Geiger. Pointflownet: Learning representations for rigid motion estimation from point clouds. In *CVPR*, 2019.

- How to write related work? Allow to answer an important question "NOVELTY!"

Research paper -V

Related work/literature review

- Theoretical table/ analysis (comparison)

Theoretical comparison among the characteristics of transition matrices with different methods.

References/ Technique	Reanalyze Data	Effected with sparsity of data	Temporal Time Dependent	GSs	Discrete level	Precise
[15] Baum-Welch	√	√	√	✗	✗	✗
[19] Multi-canonical Method	√	√	✗	✗	✗	✗
[13,14] Frequentist Approach	√	√	√	✗	✗	✗
[20] Markov State Model	√	√	√	✗	√	✗
Proposed method	✗	✗	✗	√	√	√

- Include 8 – 10 papers/methods (Good)

Research paper -VI

Problem formulation/ma

- Introduction (mathematical) t

Nomenclature

Math symbol	Description
$\tilde{\boldsymbol{X}}, \boldsymbol{X}^{(l)}$	Generalized States (GS) an
l	lth times derivative
x	Zero-order time derivativ $X^{(0)}, n = 1$
v	First-order time derivativ $X^{(1)}, n = 1$
$\boldsymbol{x}$	Zero-order time derivativ $\boldsymbol{X}^{(0)}, n = 2$
$\boldsymbol{v}$	First-order time derivativ $\boldsymbol{X}^{(1)}, n = 2$
$\hat{\boldsymbol{x}}_{k+1\|k}$	Prediction of next state
$\mathrm{x}^{(l)}$	Coordinate system, $[\mathrm{x}^{(0)}, \mathrm{x}^{(1)}, ..., \mathrm{x}^{(\mathcal{L})}]^T$
$\boldsymbol{\mu}_i^{(l)}$	Unit vector defining the o tractor i
$\boldsymbol{P}_i$	Defines line of the attracti i attractor
$\boldsymbol{P}_i^0$	Defines the position vecto traction $\boldsymbol{P}_i$
m_i	Position of ith attractor wl
k	Time indexes

III. FedRSU: Federated Learning on RSUs

In this section, we formulate the problem of scene flow estimation, describe our novel design of multi-modal recurrent self-supervised learning for scene flow estimation at each RSU, and finally present the overall FedRSU system.

A. Problem Formulation

The focused task is scene flow estimation that describes the motion vector of points in 3D space, which is a crucial component to support various downstream tasks, including segmentation [19], instance segmentation [20], object detection [21], motion prediction [22], trajectory prediction [24], and more. To achieve this, our core goal is to train a scene flow estimation model on the constant stream of RSU data in a recurrent self-supervised paradigm. As is shown in Fig. 2, in the data stream of RSU sensors, the prediction at each frame can be supervised by its following future frame. Therefore, in our method, the denotation t can be any frame in the data stream.

Denote the dataset as $\mathcal{D} = \{(\mathbf{X}_i^{(pc)}, \mathbf{X}_i^{(img)})\}_{i=1}^N$, where N is the number of samples of the dataset. $\mathbf{X}_i^{(pc)} = (\mathbf{P}_i^{t-1}, \mathbf{P}_i^t)$, where source point cloud $\mathbf{P}_i^{t-1} = \{p_a^{t-1} \in \mathbb{R}^3\}_{a=1}^{n_1}$ and target point cloud $\mathbf{P}_i^t = \{p_b^t \in \mathbb{R}^3\}_{b=1}^{n_2}$ are from two consecutive time frames. $\mathbf{X}_i^{(pc)} = (\mathbf{I}_i^{t-1}, \mathbf{I}_i^t)$ are the corresponding images.

Basically, the objective of scene flow estimation is to estimate a motion vector $f_a \in \mathbb{R}^3$ of point $p_a^{t-1} \in \mathbb{R}^3$ from the first frame $\mathbf{P}_i^{t-1}$ to its possible new position in the second frame $\mathbf{P}_i^t$. Due to the data sparsity of LiDAR point clouds and occlusion caused by moving objects, p_a may not have its corresponding point in $\mathbf{P}_i^t$ and the point numbers n_1 and n_2 may differ. Therefore, the predicted flow $\mathbf{F}_i = \{f_a \in \mathbb{R}^3\}_{a=1}^{n_1}$ is not the point-to-point correspondences between $\mathbf{P}_i^{t-1}$ and $\mathbf{P}_i^t$, but the motion representation describing the scene.

Research paper -VI

Problem formulation/ma

- Introduction (mathematical) t

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Research paper -VI

Methodology

- Block diagram, table o
  - Try to avoid mathemat
  - Should be a generic dia

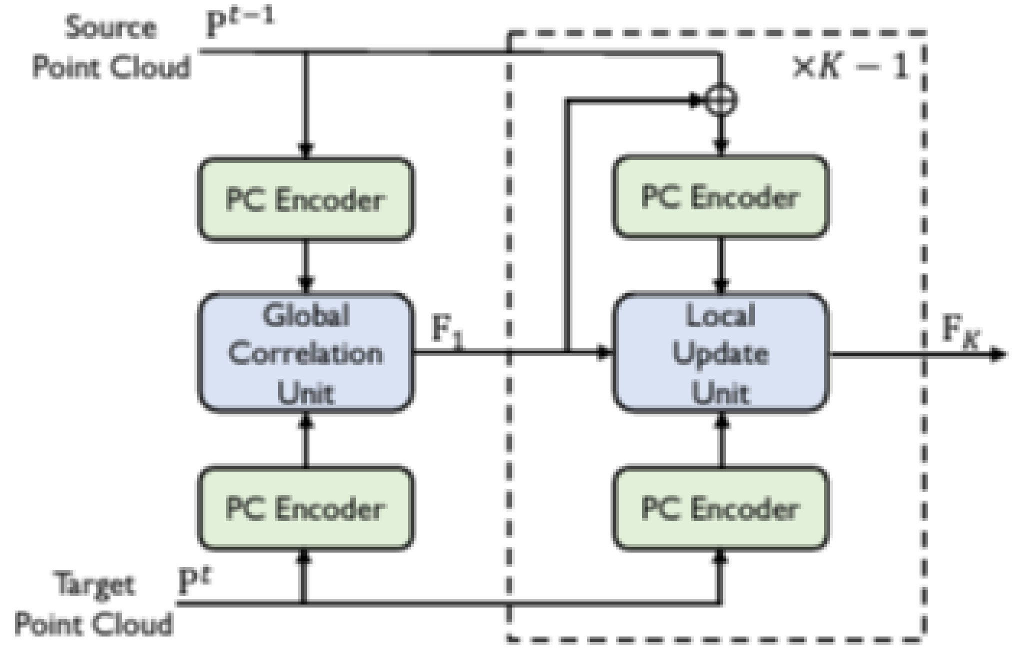


Fig. 4. Overview of the scene flow model architecture. We follow the architecture of Flowstep3d [27] and predict the scene flow in a coarse to fine manner.

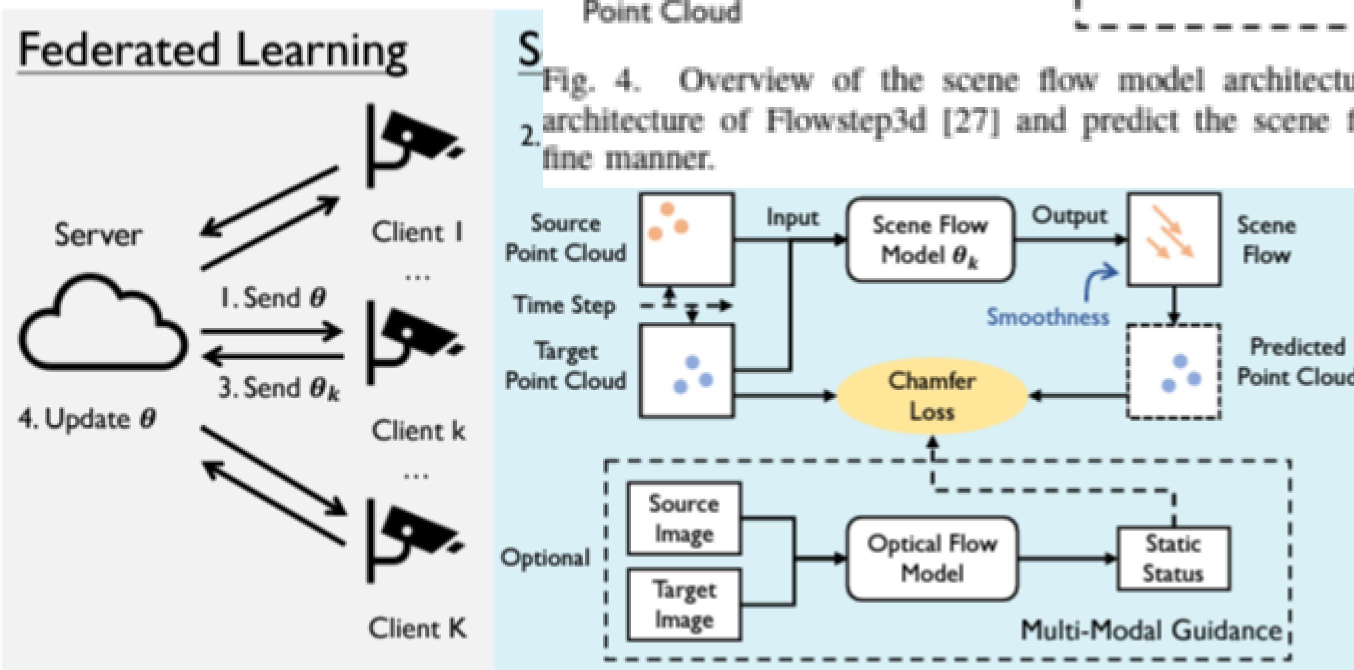


Fig. 3. Overview of FedRSU framework. FedRSU consists of four steps. 1) The server sends the global model to all available clients, 2) each client updates local model supervised by Chamfer loss and smoothness regularization, 3) each client sends local model to the server, 4) the server updates global model by aggregating received local models. These four steps will iterate for multiple rounds.

Research paper -VI

- Subsections: each sub section is linked with other, should be like story telling
- End of a sub-section provide an intro of the next subsection
- Every figure, table etc. should discussed/cited

Research paper -VII

<u>Results and discussion</u>

- Figure/results labelling, discussion should call each figure and provide discussion
- Position of figure/table in paper/report
- Discuss whatever you **claim** in your methodology/ introduction and related work section
- Prove it with figures and numbers
- Qualitive analysis vs quantitative analysis

Repeat the headings from your methodology!
Prove what you claim!

Research paper -VII

Results and discussion

- Comparison
  - With state of art method
  - Test your methodology with various public datasets
  - Provide ablation study
  - Quantitative comparison
- You don't necessarily have to include all the data you've gotten during the semester. This isn't your diary.
- Use appropriate methods of showing data. Don't try to manipulate the data to make it look like you did more than you actually did.

Research paper -VIII

Conclusion and future work

- Should have continuity with your abstract

- Your conclusion is your chance to have the last word on the subject. The conclusion allows you to have the final say on the issues you have raised in your paper, to summarize your thoughts, to demonstrate the importance of your ideas, and to propel your reader to a new view of the subject. It is also your opportunity to make a good final impression and to end on a positive note.

Research paper -IX

<u>References/ acknowledgement</u>

- It is important to properly and appropriately cite references in scientific research papers in order to acknowledge your sources and give credit where credit is due.

Research paper -X

Appendices

- Additional result, not much important but comprises of the interesting findings!

Experimental dataset

- Description of the dataset; whether its public dataset or not

How to start writing a paper?

- Start with methodology
- Then result and discussion
- Observe the “conclusion”
- And then write introduction and related work/literature review

Plagiarism

- Self-plagiarism
- AI generated content
- Plagiarism vs novelty
- How much plagiarism is allowed?

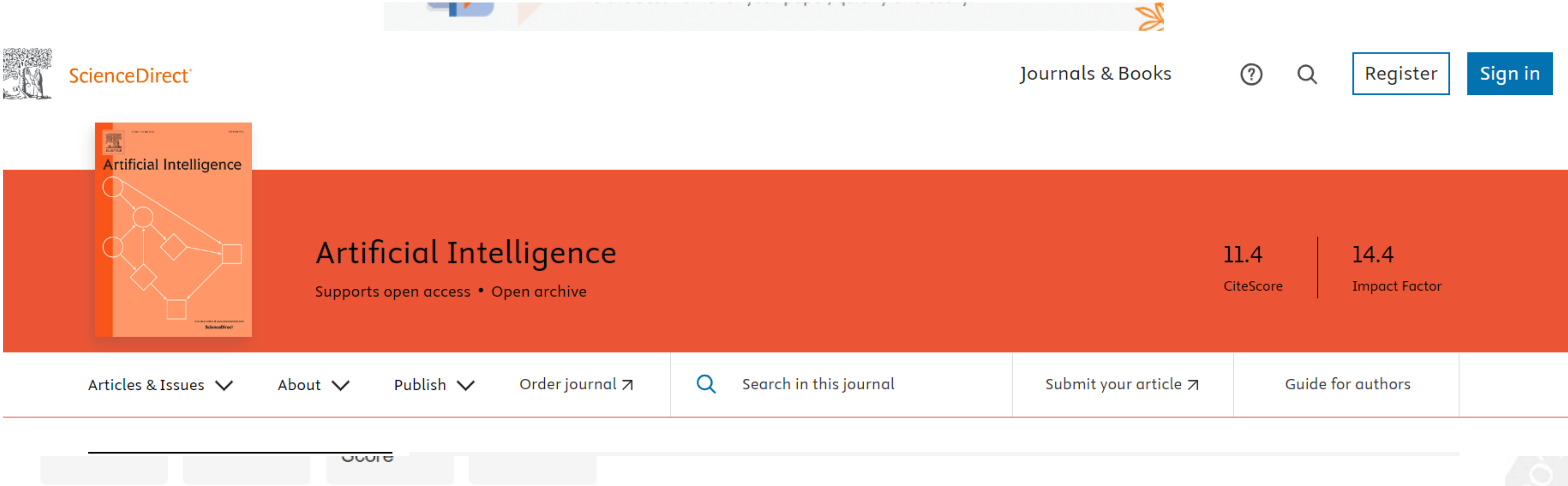
Research platform

- Researchgate (https://www.researchgate.net/)
- Google scholar (https://scholar.google.com/)
- Web of science (https://www.webofscience.com/)
- Scopus (https://www.scopus.com/)

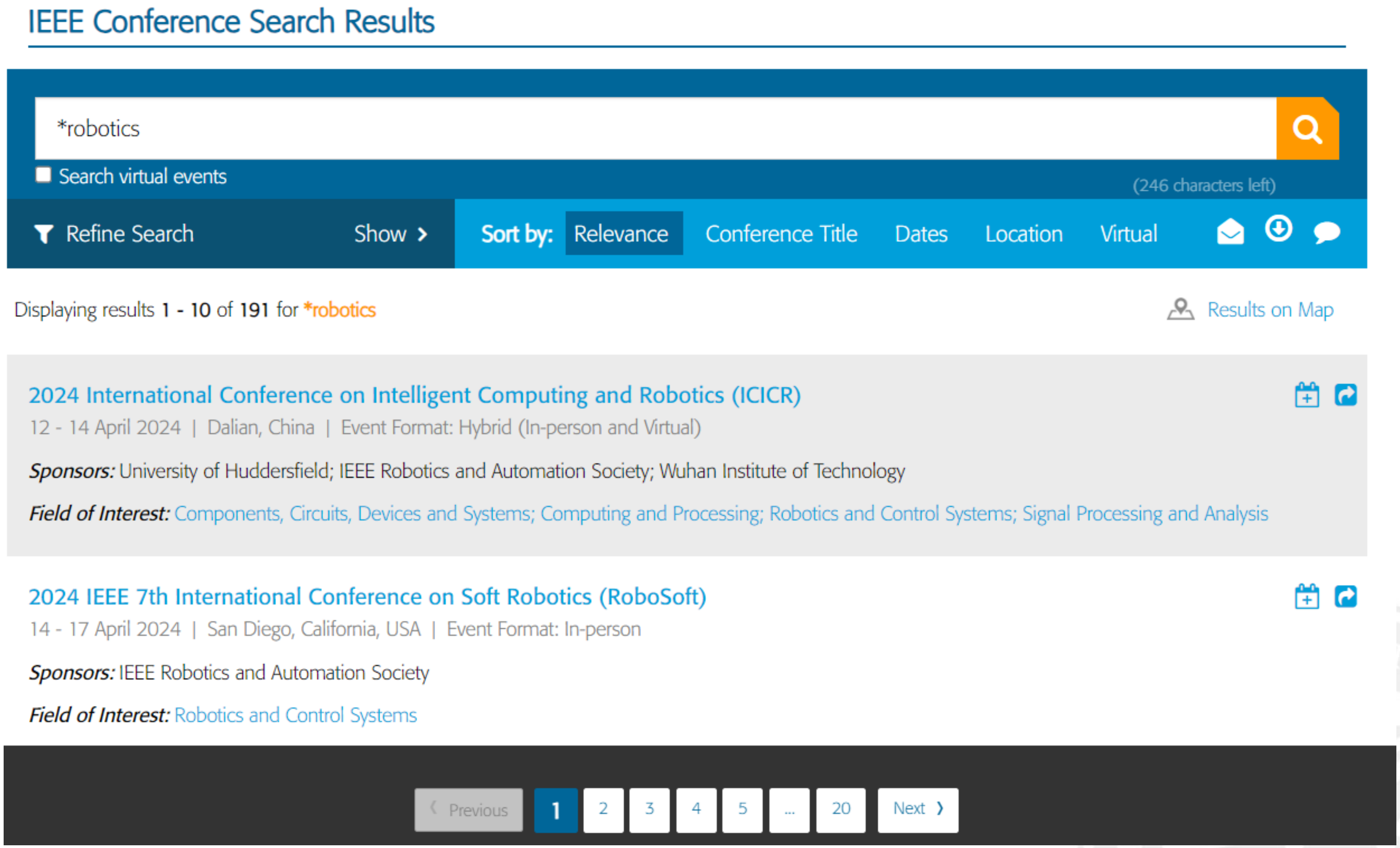
etc.

Ranking Matrices

- Hindex
- Impact factor
- Cite score (journal)
- Citation score (researchers) etc.



Submission/searching platform



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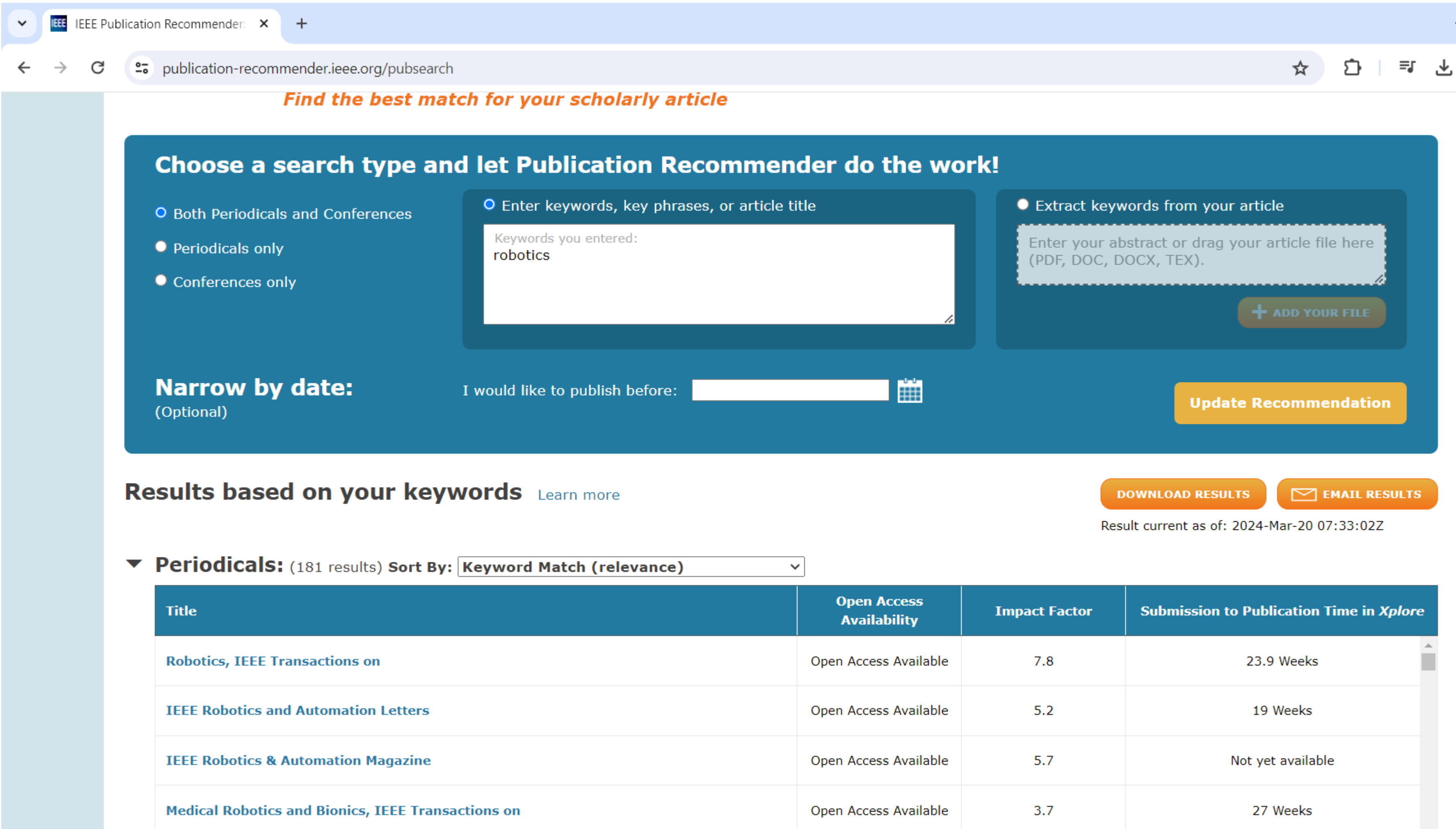

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IEEE Robotics and Automation Letters	Open Access Available	5.2	19 Weeks
IEEE Robotics & Automation Magazine	Open Access Available	5.7	Not yet available
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Conference Data

Search: robotics

Name	Abbrv.	Rank	Source
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Australasian Conference on Robotics and Automation	ACRA	B	ERA
Automation and Robotics International Symposium	ISARC	B	ERA

Submission platform

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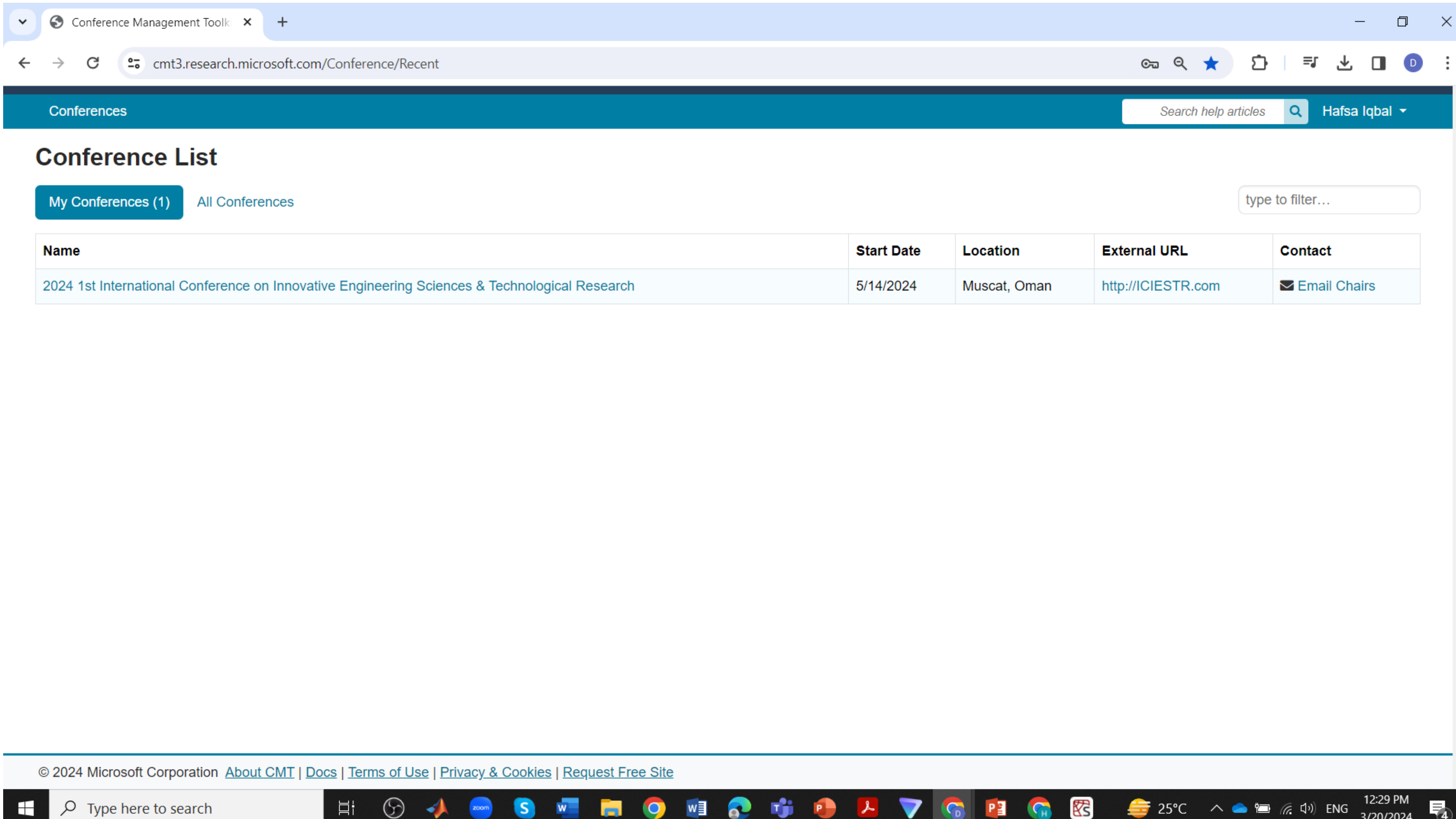

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Upcoming Conferences

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Conferences in 2024

ISCS 2024	ISCS 2024 SICE Control Division — 2024 SICE International Symposium on Control Systems, March 18-20, 2024, Hiroshima University, Higashi-Hiroshima, Japan	**2024 SICE International Symposium on Control Systems (ISCS).** March 18-20, 2024, Higashi-Hiroshima, Japan	• Submit a contribution to ISCS 2024 • Contact the ISCS 2024 organizers • Log in
	Last updated October 2, 2023. Submission deadline is Nov. 6, 2023		
Control 2024	Control 2024 — The 14th United Kingdom Automatic Control Council International Conference on Control, April 10-12 2024, Winchester UK	**2024 UKACC 14th International Conference on Control (CONTROL).** April 10-12, 2024, Winchester, UK	• Submit a contribution to Control 2024 • Control 2024 online program now available • Contact the Control 2024 organizers • Log in
	Last updated June 15, 2023. Submission deadline is Sept 15, 2023. September 14, 2023 Initial submission deadline changes: Contributed paper October 15, 2023, Extended abstract October 15, 2023, [...] More		
IACAS 2024	IACAS — The 63rd Israel Annual Conference on Aerospace Sciences, 9 May, 2024	**63rd Israel Annual Conference on Aerospace Sciences.** May 9, 2024, Haifa, Israel	• Submit a contribution to IACAS 2024 • Contact the IACAS 2024 organizers • Log in

Ranking Matrices

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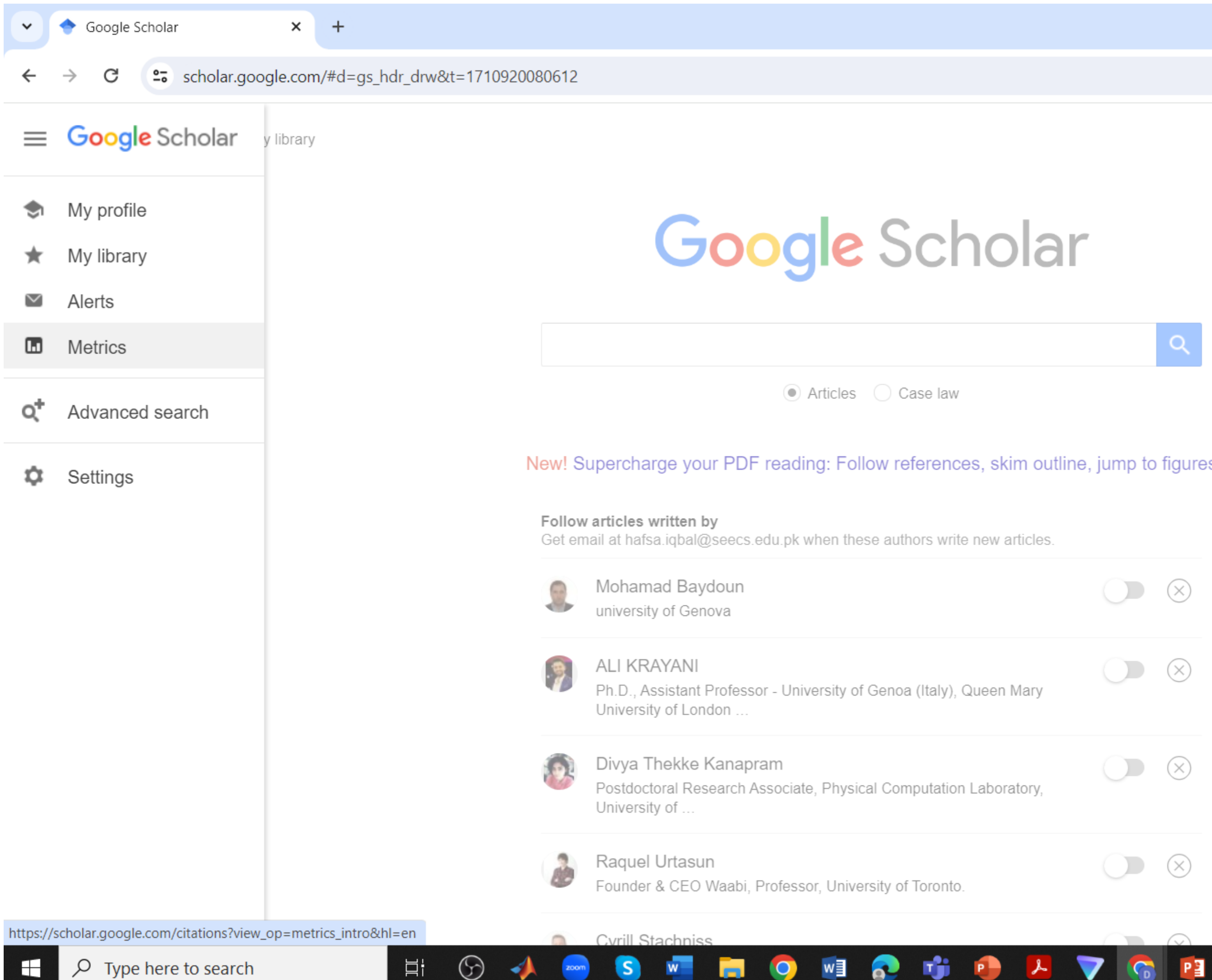

computer vision - Google Schol

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computer vision

Top 20 publications matching *computer vision*

	Publication	h5-index	h5-median
1.	IEEE/CVF Conference on Computer Vision and Pattern Recognition	422	681
2.	European Conference on Computer Vision	238	390
3.	IEEE/CVF International Conference on Computer Vision	228	366
4.	Procedia Computer Science	113	166
5.	IEEE/CVF Computer Society Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)	108	176
6.	IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)	95	150
7.	IEEE Transactions on Visualization and Computer Graphics	90	126
8.	International Journal of Computer Vision	88	165
9.	British Machine Vision Conference (BMVC)	77	128
10.	IEEE/CVF International Conference on Computer Vision Workshops (ICCVW)	66	102
11.	Computer Science Review	62	116
12.	Asian Conference on Computer Vision (ACCV)	60	92
13.	Computer Graphics Forum	59	90
14.	International Journal of Advanced Computer Science and Applications	55	81
15.	IEEE Symposium on Foundations of Computer Science (FOCS)	50	74
16.	Computer Vision and Image Understanding	49	94
17.	Social Science Computer Review	48	81

Quartiles

- Q1
- Q2
- Q3
- Q4

Best computer science conferences

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Rank		Conference Details	Impact Score
1	IEEE	**Computer Vision and Pattern Recognition** 18-06-2023 - 22-06-2023 - **Vancouver**	60.70
2	Springer	**European Conference on Computer Vision** 29-09-2024 - 04-10-2024 - **Milan**	38.70
3	WAGENINGEN	**Neural Information Processing Systems** 12-12-2023 - 14-12-2023 - **New Orleans**	38.50
4	Open Review .net	**International Conference on Learning Representations** 01-05-2023 - 05-05-2023 - **Kigali**	35.70
5	IEEE	**International Conference on Computer Vision** 11-10-2021 - 11-10-2021 - **Montreal**	31.80
		AAAI Conference on Artificial Intelligence	

Type here to search 25°C ENG 12:37 PM 3/20/2024

Best Electrical and Electronics Conferences

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Search by name

Rank		Conference Details	Impact Score
1	IEEE	**International Conference on Communications** 28-05-2023 - 01-06-2023 - **Rome**	8.30
2	IEEE	**IEEE Conference and Exhibition on Global Telecommunications** 04-12-2023 - 08-12-2023 - **Kuala Lumpur**	6.80
3	IEEE	**International Electron Devices Meeting** 09-12-2023 - 13-12-2023 - **San Francisco**	6.50
4	IEEE	**Power and Energy Society General Meeting** 17-07-2022 - 21-07-2022 - **Denver**	6.30
5	IEEE	**International Conference on Robotics and Automation** 29-05-2023 - 02-06-2023 - **London**	6.30

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Steps to Publish in Conference

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27th IEEE International Conference on Intelligent Transportation Systems
September 24- 27, 2024
Edmonton, Canada

IEEE
ITSC 2024

Submission Deadlines Extended

After multiple requests, the organization committee has decided to extend the submission
These **new deadlines are strict**, and no further extensions will be granted.

New Conference deadlines

~~April 08, 2024~~ April 22, 2024: Proposals due for invited sessions

~~April 15, 2024~~ May 01, 2024: Submission deadline for regular and invited session papers

~~May 30, 2024~~ June 07, 2024: Proposals due for workshops and tutorials

~~June 30, 2024~~ July 07, 2024: Decision notification

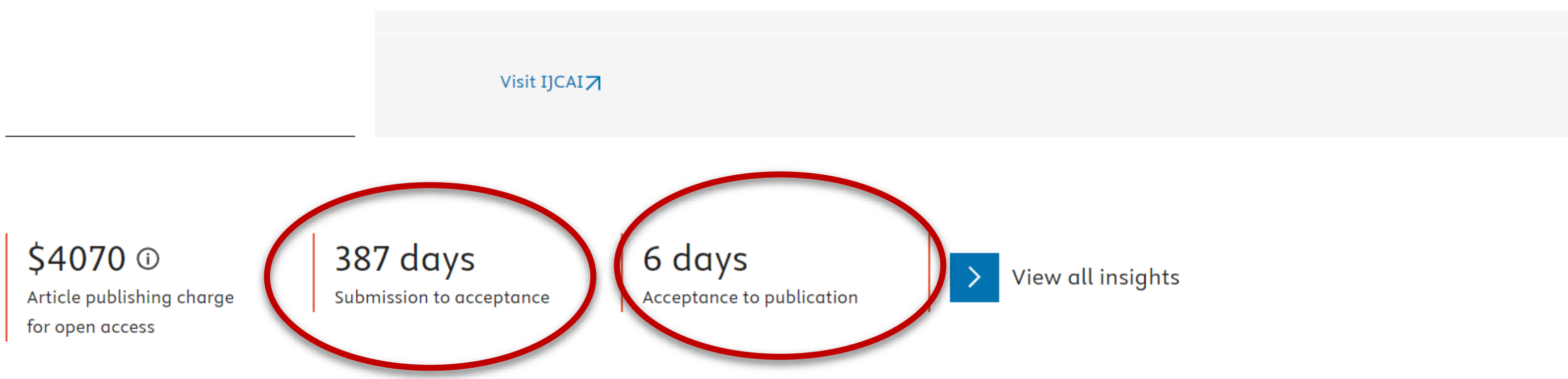
July 31, 2024: Final paper submission deadline

Invited session papers must be submitted via Papercept, using the code of the approved se
with the approved proposers (to be shared with authors) before May 1st. Regular papers an
submitted via Papercept.

https://ieee-itsc.org/2024/

Time to Publish in Journals

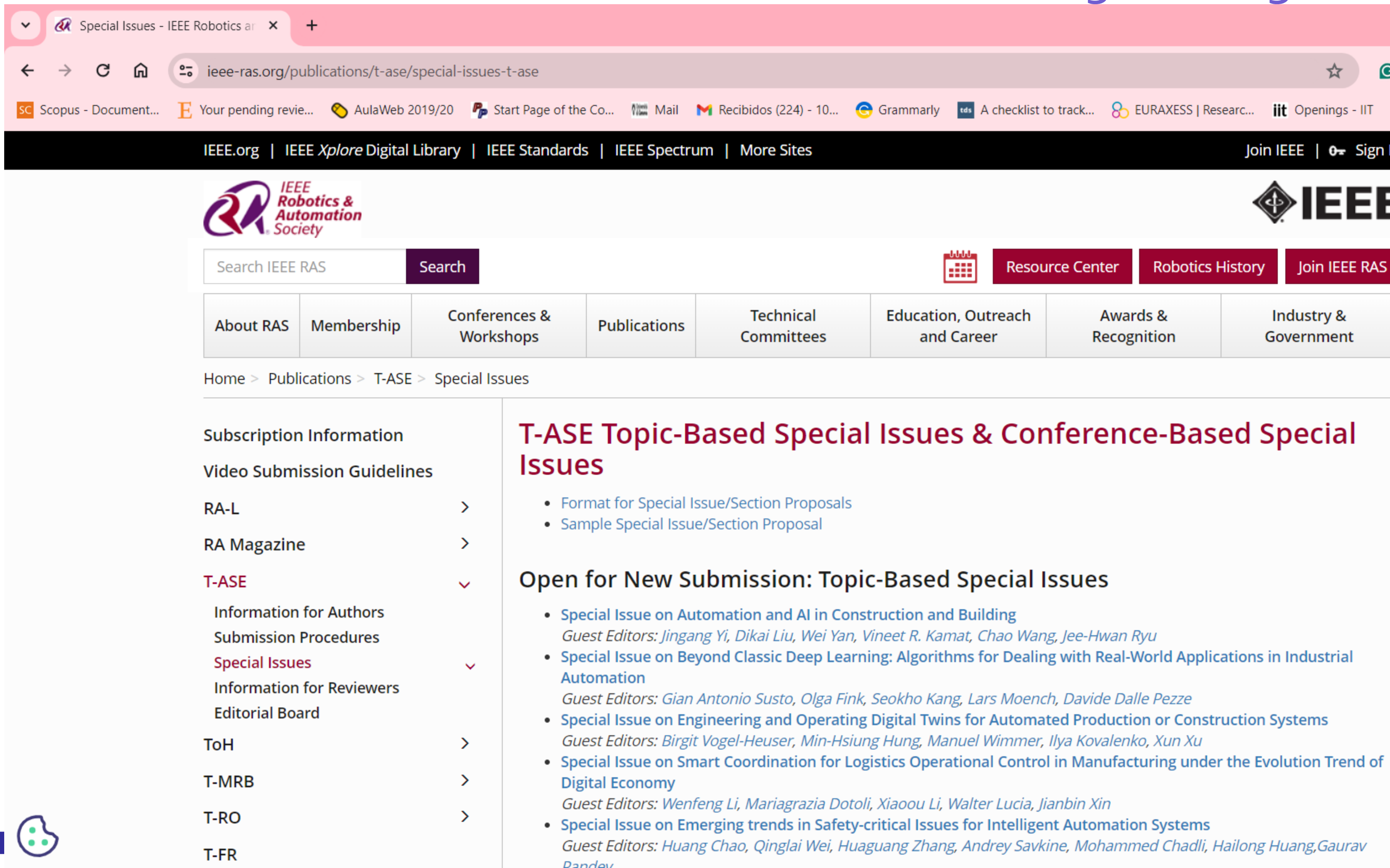
- https://www.sciencedirect.com/journal/artificial-intelligence



Special issues

https://www.ieee-ras.org/publications/t-ase/special-issues-t-ase

- IEEE Transactions on Automation Science and Engineering



Platform

- Github
- LinkedIn