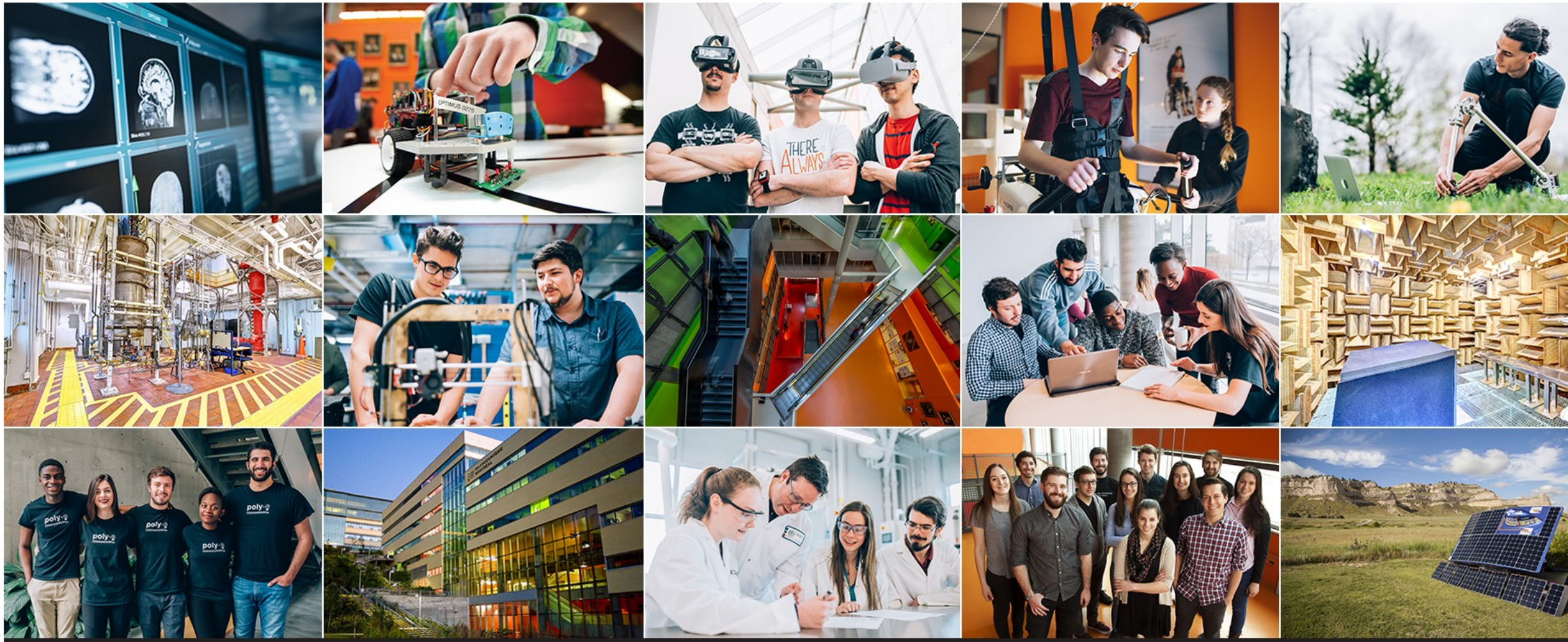

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INF[67]900E Lecture 5 – Paper Structure and Dissemination

Dr. Bentley James Oakes

bentleyjoakes.github.io

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Deliverables

February 8th * TODAY *****

- One/two page critical review of a paper
- Template on Moodle
- Evaluated on being **constructive**, **specific, professional, structured**
  - 0 to 3 points for each category

February 22ndth

- One page evaluation of another student's review
- Template on Moodle
- Evaluated out of 5 marks on having **lessons present, lessons missing, general feedback**

February 29ndth

- NSERC proposal, one page text, one page references
- Must fit NSERC presentation guidelines (see Moodle)
- Evaluated on structure and clarity, through peer review

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Last Lecture

1. Plan your writing
2. Plan your research
3. ~~Paper structure~~
4. Proposal structure

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This Lecture

1. Paper structure
2. Disseminating your work

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Paper Structure

Paper Structure

- Depends on type of research
  - Literature survey, vision paper, proposed approach, etc.
- Depends on type of paper
  - Journals have ~20-30 pages, conferences have ~10 pages

1) Title
2) Abstract
3) Introduction
4) Background (for journal)
5) Approach
6) Evaluation set-up / results
7) Discussion
8) Related Work
9) Conclusion

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Most Important Part? (Opinion)

1) Title
2) Abstract
3) Introduction
4) Background (for journal)
5) Approach
6) Evaluation set-up / results
7) Discussion
8) Related Work
9) Conclusion

Most Important Part – Intro (Opinion)

1) Title
2) Abstract
3) **Introduction**
4) Background (for journal)
5) Approach
6) Evaluation set-up / results
7) Discussion
8) Related Work
9) Conclusion

Introduction:

a) Context to the problem

b) What's the **specific problem** addressed?

c) Brief summary of the **approach**

d) **Contributions** and **research questions**

e) Structure of the paper

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Contributions Examples

the main contributions of this paper are: (a) an adaptation of the SBFL approach to the symbolic execution verification results, and (b) an empirical evaluation of the approach on a set of example model transformations.

This paper's contributions are therefore: (i) detailing how the ML-based FI process uses the available data within the SAHARA methodology to automatically produce hazardous situations, (ii) providing an example of the FI and SAHARA processes on a use case, including an indication of the approach performance, and (iii) a discussion of the benefits and drawbacks of placing ML-based FI within the SAHARA process.

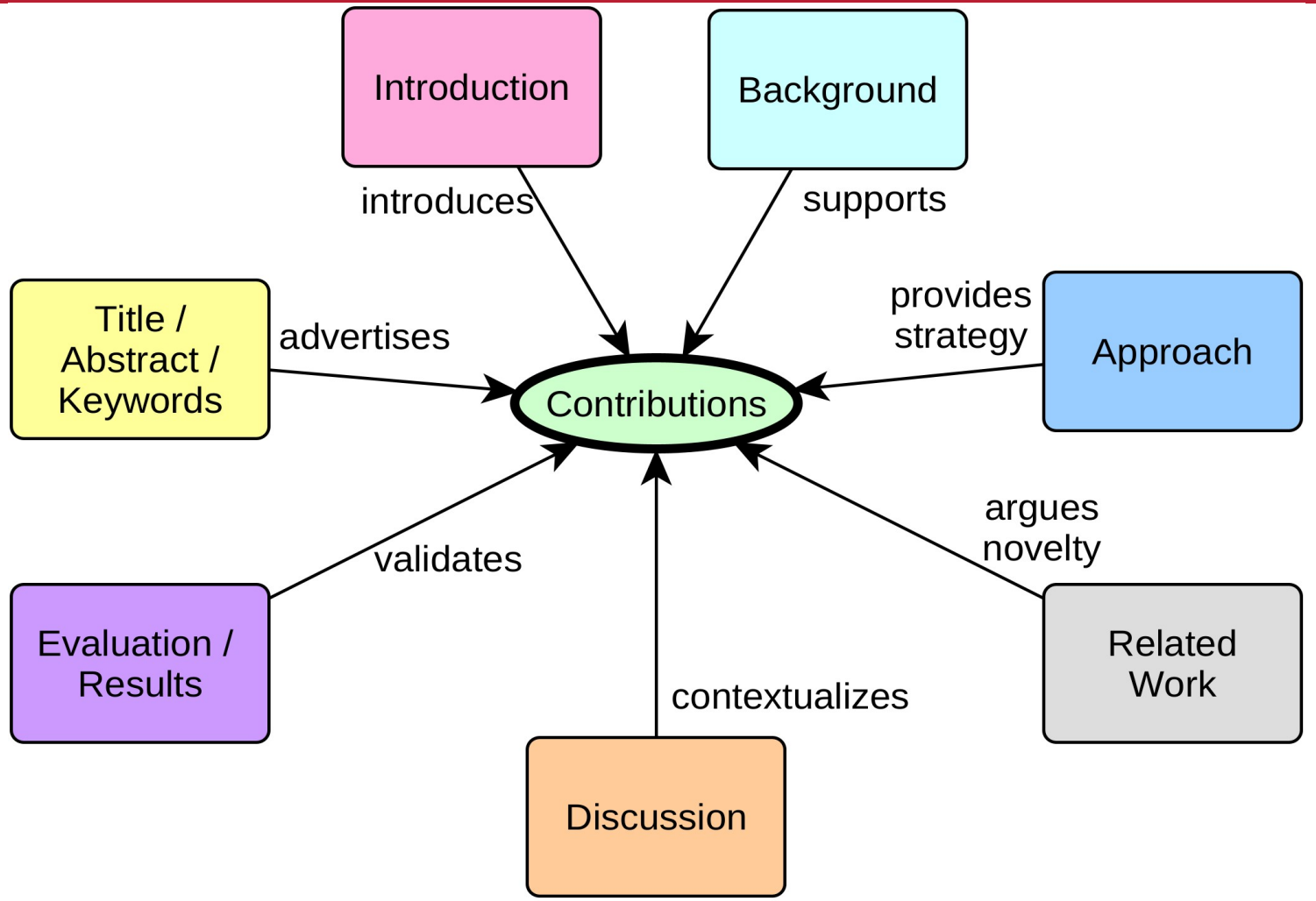
The core contributions of this paper are to explain the implementation of this contract-based approach on an industrial use-case, as well as provide examples of the benefits of this approach. Section II describes the industrial use-case,

Contributions and Structure This paper presents these specific contributions:

– Section 2: A high-level architecture relating a KG to DTs.

Contributions. Our contributions in this paper are: a) a formalization of the problem of breaking algebraic loops in co-simulations, b) an optimal, but costly, algorithm to solve it, and c) multiple cost-effective heuristic algorithms.

Paper Centres Around Contributions



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Title / Abstract / Keywords

EXAMINING MODEL QUALITIES AND THEIR IMPACT ON DIGITAL TWINS

ABSTRACT

Digital Twins (DTs) are built using modelling and simulation techniques in complex domains such as cyber-physical systems. However, further formal investigation is required for how a DT and the services it provides relate to the qualities of the models used by a service. Specifically, this article examines when a DT service can be said to have the qualities of *relevant*, *verifiable*, *substitutable*, and *faithful* based on the results of checking *properties* in comparison to the actual system. Using an incubator system as our running example, we show how a DT service relies on multiple models, present the consequences when these qualities are violated, and discuss strategies for adapting models to ensure these qualities.

Keywords: digital twins, verification, model quality, fidelity, substitutability, cyber-physical systems.

Oakes et al (2023). Examining Model Qualities and Their Impact on Digital Twins.
In 2023 Annual Modeling and Simulation Conference (ANNSIM) (pp. 220-232). IEEE.

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How to write a scientific abstract

1) In one sentence, what's the topic?
2) State the problem you tackle
3) Summarize (in one sentence) why nobody else has adequately answered the research question yet.
4) Explain, in one sentence, how you tackled the research question.
5) In one sentence, how did you go about doing the research that follows from your big idea.
6) As a single sentence, what's the key impact of your research?

https://www.easterbrook.ca/steve/2010/01/how-to-write-a-scientific-abstract-in-six-easy-steps/

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How to write a scientific abstract

(1) In widgetology, it's long been understood that you have to glomp the widgets before you can squiffle them. (2) But there is still no known general method to determine when they've been sufficiently glomped. (3) The literature describes several specialist techniques that measure how wizzled or how whomped the widgets have become during glomping, but all of these involve slowing down the glomping, and thus risking a fracturing of the widgets. (4) In this thesis, we introduce a new glomping technique, which we call googa-glomping, that allows direct measurement of whifflization, a superior metric for assessing squiffle-readiness. (5) We describe a series of experiments on each of the five major types of widget, and show that in each case, googa-glomping runs faster than competing techniques, and produces glomped widgets that are perfect for squiffling. (6) We expect this new approach to dramatically reduce the cost of squiffled widgets without any loss of quality, and hence make mass production viable.

https://www.easterbrook.ca/steve/2010/01/how-to-write-a-scientific-abstract-in-six-easy-steps/

Intro

Introduction:

a) Context to the problem

b) What's the **specific problem** addressed**?**

c) Brief summary of the **approach**

d) **Contributions** and **research questions**

e) Structure of the paper

Background

- Usually only for journal articles
- Mention the fundamental topics in the article needed to understand the approach

2 Background

This section introduces the background necessary for this paper. In particular, it briefly presents: (a) the model transformation used as a running example, (b) the DSLTrans transformation language used in our work, (c) the symbolic execution verification approach for proving contracts and the SyVOLT tool which takes as input DSLTrans transformations and (d) the basics of SBFL for model transformations.

Oakes et al (2023). Fault localization in DSLTrans model transformations by combining symbolic execution and spectrum-based analysis. Software and Systems Modeling, 1-27.

Approach

- Detail the proposed approach, and try to include an overview diagram

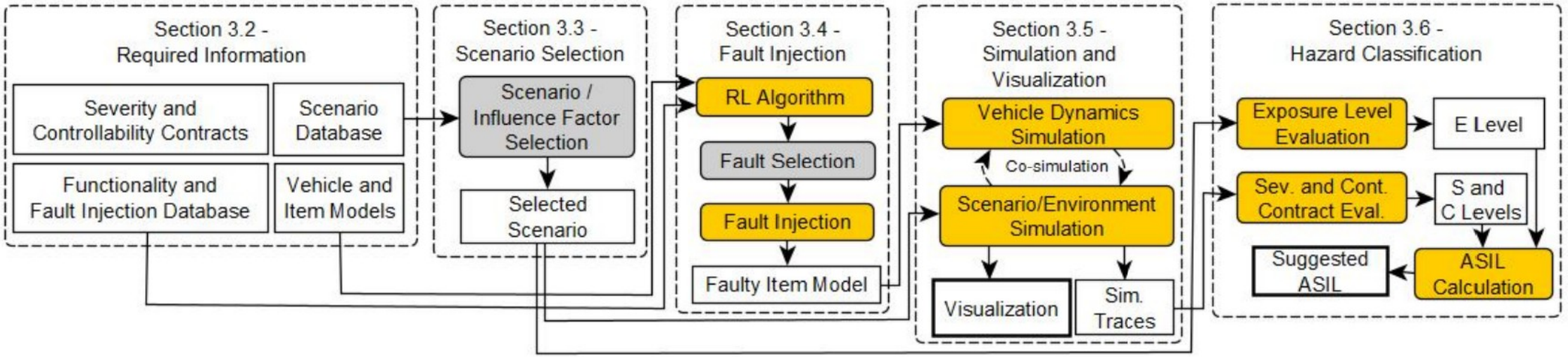


Fig. 3: The overall SAHARA architecture and workflow (adapted from [21]). Yellow blocks are automatic actions, and gray blocks are manual actions.

Oakes et al. (2021, August). Machine Learning-Based Fault Injection for Hazard Analysis and Risk Assessment. In International Conference on Computer Safety, Reliability, and Security (pp. 178-192).

Evaluation

4 Evaluation setup

This section sets up the evaluation of our approach by first defining the research questions (RQs). Then, the experimental setup is explained to detail the different example transformations, contracts, mutants and techniques used for suspiciousness-based rankings computations. The evaluation metrics used for answering each RQ are explained, and the prototype implementation and execution environment are also introduced.

Oakes et al (2023). Fault localization in DSLTrans model transformations by combining symbolic execution and spectrum-based analysis. Software and Systems Modeling, 1-27.

Results

5.2.2 RQ2.2

Question: *How do the contracts affect the results quality?*

Section 4.2.2 describes how we consider two types of contracts: a) *multi-rule contracts* (MRC), which involve elements from multiple rules in the transformation, and b) *single-rule contracts* (SRC), which are mirrored versions of the rules. From the results in Table 9 and Fig. 7, the SRCs provide a slightly better EXAM score on almost all techniques compared to the MRCs. Building these SRCs also allowed us to test our approach on the *RSS-to-ATOM* transformation which did not have usable MRCs.

Answer to RQ2.2: Single-rule contracts (SRCs) are slightly more effective than multi-rule contracts (MRCs) in our *SBFL-Verif* approach for locating faulty rules.

Oakes et al (2023). Fault localization in DSLTrans model transformations by combining symbolic execution and spectrum-based analysis. Software and Systems Modeling, 1-27.

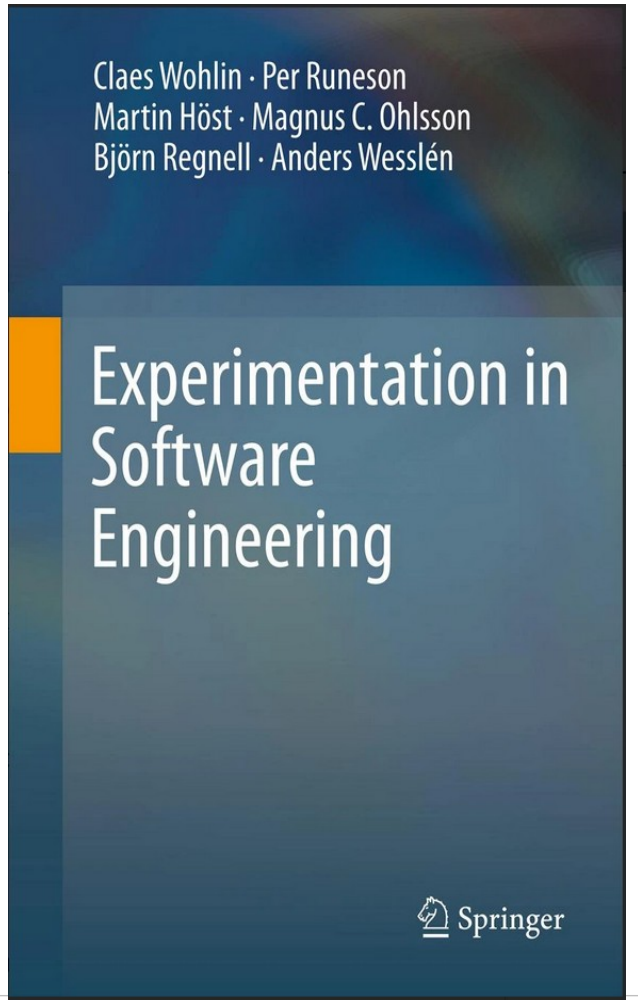
Discussion

- Often missing from papers and leads to rejection

- My structure:
  - **Benefits** of the approach
    - Based on the evaluation, argue that results are good
  - **Limitations** of the approach
    - Anticipate reviewer’s objections
  - **Threats to validity**

Threats to Validity

- **<u>Conclusion validity</u> (are the conclusions right?)**
  - Threats to obtaining conclusions from results
  - Ex. Are stats reliable and powerful enough, any random heterogeneity of subjects, repeatable?
- **<u>Internal validity</u> (was the experiment done right?)**
  - Threats that might affect the results
  - Ex. Sufficient metrics to evaluate approach, ensuring that approach was performed correctly
- **<u>Construct validity</u> (does the experiment match the problem?)**
  - Threats of the approach not matching the theory
  - Ex. Metrics not matching problem to be studied
- **<u>External validity</u> (can the results be generalized?)**
  - Threats to generalization, Ex. Subset of population studied



Wohlin, C., Runeson, P., Höst, M., Ohlsson, M.C., Regnell, B.: Experimentation in Software Engineering. Springer, Berlin (2012)

Related Work

- Mention other's work
- And **how your work is different**

- **Place before the conclusion**
  - Reader needs to understand your work to appreciate the differences

Tuncali *et al.* define STL specifications for both system- and component-level to be proved on a simulation [29]. An example is that when an object is *visible* to sensors, the object must be *detected* by the sensors within a specific time frame. An optimisation framework is then employed to find scenarios that falsify the specifications. In contrast, our work performs the optimisation on the FI to search towards the most hazardous situation, and the specifications are only for hazard classification.

Zapridou *et al.* mirror our work by presenting STL verification of properties on an ACC use case using the CARLA simulator [30]. However, our work focuses on the FI portion of determining safety, and also places the intelligent FI within the SAHARA safety assessment process.

Oakes (2021). Machine Learning-Based Fault Injection for Hazard Analysis and Risk Assessment

Conclusion

- Summarize the article, and present **potential** next steps

7 Conclusion and Future Work

This work has presented the addition of machine learning-based Fault Injection (FI) to the Simulation-Aided Hazard Analysis and Risk Assessment (SAHARA) methodology, as demonstrated on a safety-critical use case of an Adaptive Cruise Control (ACC). Specifically, Reinforcement Learning (RL) explores the param-

The natural extension of this work is to validate it within an industrial safety assessment process. In particular, performing a study following the safety engineers as they perform the standard hazard analysis and risk assessment proce-

Oakes (2021). Machine Learning-Based Fault Injection for Hazard Analysis and Risk Assessment

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Disseminating Your Work

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Behind the scenes: the struggle for each paper

By Jeff Huang, published 2021-06-14, updated 2021-08-11

https://jeffhuang.com/struggle_for_each_paper/

Takeaways:

- Papers are a mix of hard work, circumstances, and luck
- Papers depend on helping hands
- Good papers get rejected

Discoverability is Essential

- In academica, we and our research need to be visible, for:
  - Collaborations
  - Impact (e.g., citations)
  - Invitations for talks/PC/etc.
  - Job applications

    - We need to make it easy for others to know **who we are**, **what research we do**, and how **strong our research is**

How to be Discovered

- Be at seminars/workshops/conferences
  - Attending is important, presenting is better
  - Being on PC (reviewing) is great involvement
  - Organizing (track/poster chair) is even better
- Publish in high-quality venues
  - CORE ranking, impact factor
- Maintain an online presence
  - Personal site, academic profiles (Google Scholar etc), social media

Discoverability Questions

- What do they look like?
- What are their pronouns/name pronunciation?
- What's their email address/institution?
- What's their recent/past work about?
- Who do they publish with?
- What's their # of citations/h-index?

Goal of online visibility:
Make answers to these questions easy to find on your websites/profiles

Academic Profiles

Type	Name
Researcher identifier	ORCID
Identifier + more services	Web of Science
Social network	ResearchGate
Auto-populated profile (may allow editing)	Google Scholar
	Scopus
	DBLP

Note that citation count will vary between these profiles
- Scopus only scans high-quality venues, unlike Google Scholar

Consistent Maintenance

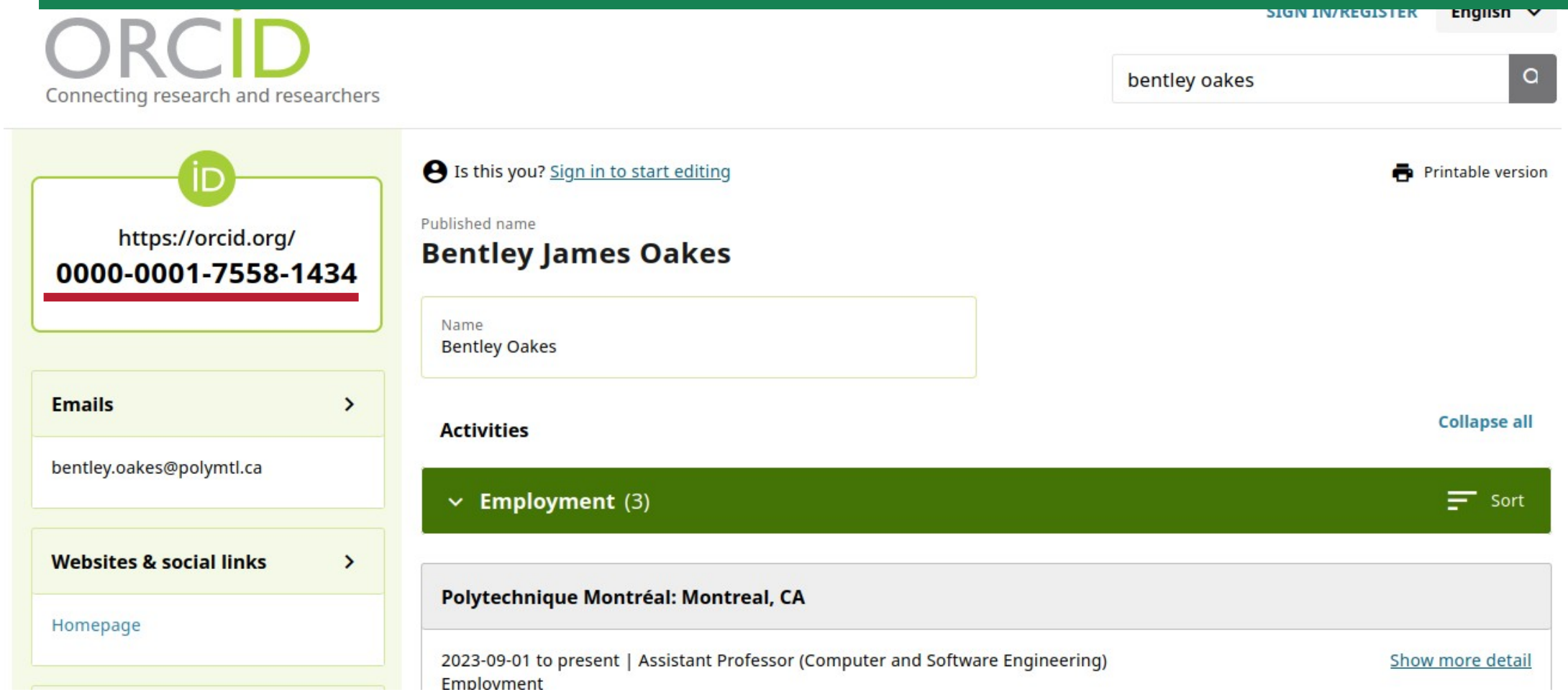
Can spend ∞ time on these sites

Do iterations, a little bit of effort every month

Answer the basic questions immediately

Consistent effort leads to opportunities and impact

ORCID - https://orcid.org/



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Bentley James Oakes

FOLLOWING

Assistant Professor, Polytechnique Montreal
Verified email at polymtl.ca - Homepage

Digital Twins Cyber-Physical System Ver… Model-Driven Engineering

TITLE	CITED BY	YEAR
Exploring Fault Parameter Space Using Reinforcement Learning-Based Fault Injection M Moradi, BJ Oakes, M Saraoglu, A Morozov, K Janschek, J Denil Dependable Systems and Networks Workshops (DSN-W), 102-109	31	2020
Specification and Verification of Graph-Based Model Transformation Properties GMK Selim, L Lúcio, JR Cordy, J Dingel, BJ Oakes International Conference on Graph Transformation, 113-129	31	2014
Full contract verification for ATL using symbolic execution BJ Oakes, J Troya, L Lúcio, M Wimmer Software & Systems Modeling 17 (3), 815-849	27	2018

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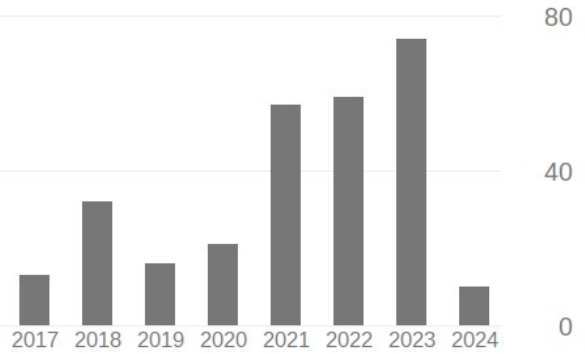

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Professor at University of Antwer.


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Bentley James Oakes

Edit

PhD · Assistant Professor at Polytechnique Montréal

Montréal, Canada | Website

Research Interest Score	202.0
Citations	246
h-index	10

Building Domain-Specific Machine Learning Workflows: A Conceptual Framework for the State-of-the-Practice

New | Article | Private full-text

December 2023

ACM Transactions on Software Engineering and Methodology

Bentley James Oakes · Michalis Famelis · Houari Sahraoui

openCAESAR: Balancing Agility and Rigor in Model-Based Systems Engineering

New | Conference Paper | Full-text available

October 2023 · Proceedings of System Analysis and Modelling Conference (SAM), In...

Maged Elaasar · Nicolas Rouquette · David Wagner · [...] · Mohammad Hamdaqa

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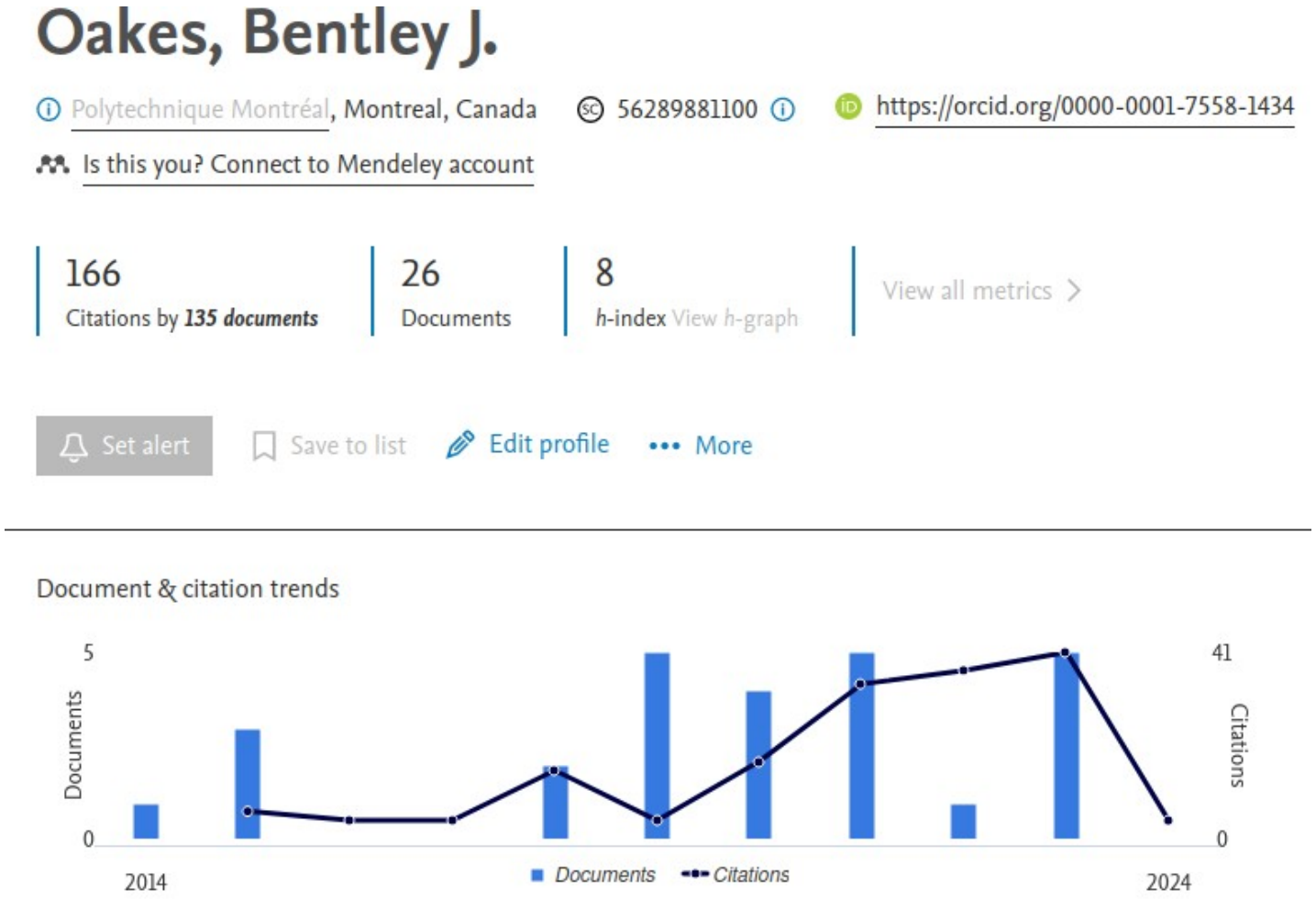

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- *affiliation:* Université de Montréal, Canada

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2023

[c22] Bentley James Oakes, Cláudio Gomes, Peter Gorm Larsen, Joachim Denil, Julien Deantoni, João Cambeiro, John S. Fitzgerald:
Examining Model Qualities and Their Impact on Digital Twins. ANNSIM 2023: 220-232

[c21] Maged Elaasar, Nicolas Rouquette, David A. Wagner, Bentley James Oakes, Abdelwahab Hamou-Lhadj, Mohammad Hamdaqa:
openCAESAR: Balancing Agility and Rigor in Model-Based Systems Engineering. MoDELS (Companion) 2023: 221-230

[c20] Mouna Dhaouadi, Bentley James Oakes, Michalis Famelis:
Towards Understanding and Analyzing Rationale in Commit Messages Using a Knowledge Graph Approach. MoDELS (Companion) 2023: 622-630

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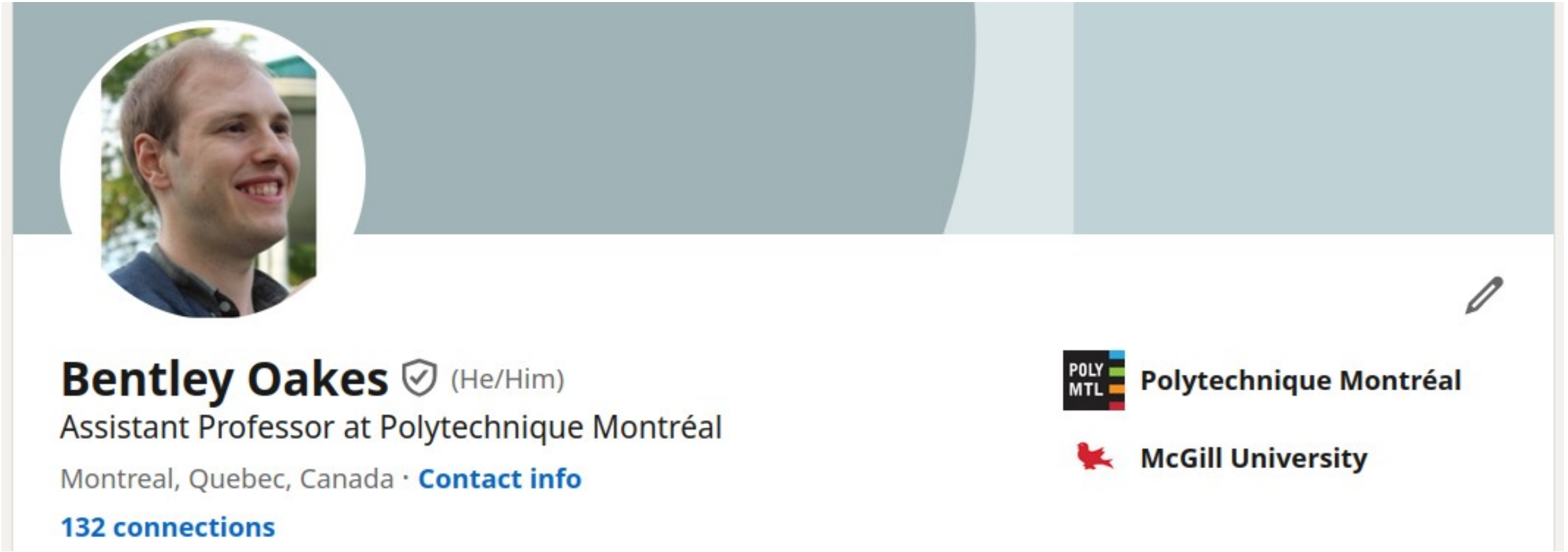

Personal Website

Dr. Bentley James Oakes

Publications Community-Building Teaching Opportunities Contact CV

I am an **Assistant Professor** in the Département de génie informatique et génie logiciel (Department of Computer and Software Engineering) at Polytechnique Montréal, Canada.

My research focuses on **enabling domain experts to efficiently capture and utilise their knowledge to build software systems (including digital twins) through a model-driven approach**. The goal is to minimise the cognitive and time effort for constructing these systems, while still maximising the insights gained during the engineering process.

My main research interests include:

- digital twins, including their structure and construction
- representation of domain-specific knowledge, such as employing ontologies and ontological reasoning
- verification of cyber-physical systems
- model-driven engineering techniques, and the intersection with low-code platforms
- model transformations and their verification
- and others, as listed on my expertise page

https://bentleyjoakes.github.io

Strong recommendation to develop a personal website

- Affiliation details, contact info
- Research interests
- List of publications, service to community
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2023

Journal Article	*Building Domain-Specific Machine Learning Workflows: A Conceptual Framework for the State-of-the-Practice*	**B. Oakes**, M. Famelis, and H. Sahraoui.	ACM Transactions on Software Engineering and Methodology	paper, bib
Article	*Examining Model Qualities and their Impact on Digital Twins*	**B. Oakes**, C. Gomes, J. Denil, J. Deantoni, J. Cambeiro, J. Fitzgerald, and P. Larsen.	In 2023 Annual Modeling and Simulation Conference (ANNSIM) (pp. 220-232)	paper, bib, presentation

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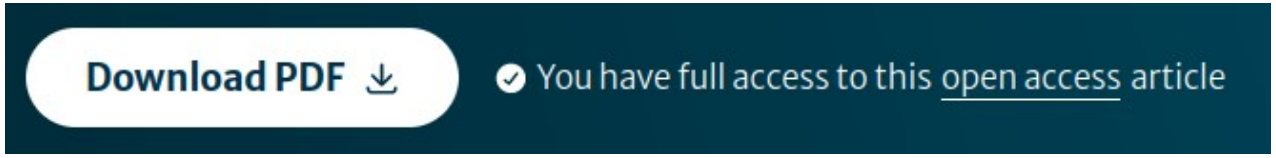

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THANK YOU!

Topics:

- 1. Paper structure
- 2. Disseminating your work

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