Rafał Kucharski *born October 17, 1986*

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Post-doctoral researcher • SmartPTLab • TU Delft • Netherlands
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• website • scholar • orcid • researchgate • linkedin • git-hub

Summary

I research complex social systems: **urban mobility**. Congested, urban multimodal networks used by millions of agents to reach their destinations and leaving huge sets of mobility traces ready to be applied for **modelling, optimisation, design and control**.

I work with Oded Cats at TU Delft in his ERC Starting Grant Critical MaaS. I did PhD with Guido Gentile in non-equilibrium dynamic traffic assignment.

Since 2019 I published 8 journal papers and submitted another 6. In total, I published 9 IF journal papers (worth 1000MNiSW points), including two first-authored Q1 papers (200p). I co-authored with ten researchers from four countries.

From 2021 to 2024 I will run the 1,1 mln PLN **NCN Opus Grant** on Shared Mobility in the pandemic times.

Outside of academia I was:

- Data Scientist at NorthGravity developing AWS-based portfolio or real-time production-ready **ML** algorithms.
- R&D Developer at PTV SISTeMA implementing algorithms into PTV Optima real-time traffic forecasting models.

Research Experience

TU Delft — Delft, Netherlands
postdoctoral researcher — *2019 – 2021*
PostDoc in the ERC Starting Grant of prof. Oded Cats **Critical MaaS**.

Cracow University of Technology — Kraków
assistant professor — *2016-2019*
Research and teaching at Department of Transportation Systems.

Cracow University of Technology/ La Sapienza Universita di Roma — Kraków, Rome
PhD — *2011 – 2015*
Simulation of rerouting phenomena in Dynamic Traffic Assignment with the Information Comply Model, supervisor: prof. Andrzej Szarata, co-supervisor: prof. Guido Gentile, La Sapienza

Cracow University of Technology — Kraków, Karlsruhe
MSc — *2005 – 2010*
Transportation Engineering, master thesis written at *KIT Karlsruhe* (*Erasmus*)

Jagiellonian University — Kraków, Poland
no degree — *2006 – 2008*
Philosophy, undergraduate studies

Professional Experience

North Gravity — senior data scientist
big-data r&d software developer — *2017 – 2019*
Software architect and algorithm designer for AWS-based real-time solutions for data-science. Implementing Python based algorithms for clustering (`scikit-learn`), forecasting (`keras`), data-mining (`pandas`), cloud computing (`SageMaker`), etc.

PTV SISTeMA — r&d developer
real-time DTA models — *2012 – 2015*
Developing algorithms for real-time, large scale dynamic traffic assignment. Implemented novel gradient-based implicit paths assignment (published in *TR:B*) into application. Developer of new modules and functionalities (VMS, fixed-path rerouting, Rolling-horizon model).

i2 intelligent infrasturcture — founder, developer

IT solutions for transportation engineering, software add-ons, consulting, modelling *2010 – 2013*

Department of Transportation Systems, Cracow Univeristy of Technology MODELLER, PROJECT MANAGER

Strategic transport models *2010 – 2015*

Head of modelling team for demand models of Standard Regional Model (2016), Warsaw Agglomeration (2015), Warsaw Region (2014), Krakow Agglomeration (2013), Krakow Region (2012). Member and/or team-leader in national level research grants.

Publications

Journal papers • total IF: **24,5** • total MNiSW: **990**

1. **Kucharski**, R. & Cats, O. Exact matching of attractive shared rides (ExMAS) for system-wide strategic evaluations. *Transportation Research Part B: Methodological* **139,** 285–310 (2020).
IF:**4.79**, MNiSW:**200**pkt.
2. **Kucharski**, R., Fielbaum, A., Alonso-Mora, J. & Cats, O. If you are late, everyone is late: late passenger arrival and ride-pooling systems' performance. *Transportmetrica A: Transport Science,* 1–24 (2020).
IF:**2.60**, MNiSW:**100**pkt.
3. Drabicki, A., **Kucharski**, R., Cats, O. & Szarata, A. Modelling the effects of real-time crowding information in urban public transport systems. *Transportmetrica A: Transport Science* **0,** 1–39 (2020).
IF:**2.60**, MNiSW:**100**pkt.
4. Niedzielski, M. A. & **Kucharski**, R. Impact of commuting, time budgets, and activity durations on modal disparity in accessibility to supermarkets. *Transportation Research Part D: Transport and Environment* **75,** 106–120 (2019).
IF:**4.05**, MNiSW:**140**pkt.
5. **Kucharski**, R. & Gentile, G. Simulation of rerouting phenomena in Dynamic Traffic Assignment with the Information Comply Model. *Transportation Research Part B: Methodological* **126,** 414–441 (2019).
IF:**4.79**, MNiSW:**200**pkt.
6. Cantelmo, G., **Kucharski**, R. & Antoniou, C. Low-Dimensional Model for Bike-Sharing Demand Forecasting that Explicitly Accounts for Weather Data. *Transportation Research Record* **2674,** 132–144 (2020).
IF:**0.695**, MNiSW:**40**pkt.
7. **Kucharski**, R., Drabicki, A., Paszkowski, J. & Szarata, A. Lewis–Mogridge Points: A Nonarbitrary Method to Include Induced Traffic in Cost-Benefit Analyses. *Journal of Advanced Transportation* **2020,** 3096260 (2020).
IF:**1.67**, MNiSW:**70**pkt.
8. **Kucharski**, R., Drabicki, A., Żyłka, K. & Szarata, A. Multichannel queueing behaviour in urban bicycle traffic. *European Journal of Transport and Infrastructure Research* **19** (2019).
IF:**1.70**, MNiSW:**70**pkt.
9. **Kucharski**, R. & Drabicki, A. Estimating Macroscopic Volume Delay Functions with the Traffic Density Derived from Measured Speeds and Flows. *Journal of Advanced Transportation* **2017** (2017).
IF:**1.67**, MNiSW:**70**pkt.

Pre-prints (under journal review)

1. **Kucharski**, R., Cats, O. & Sienkiewicz, J. *Virus spreading in ride-pooling networks. Can ride-pooling become a safe and sustainable mobility alternative for pandemic urban systems?* IF:**3.998**, MNiSW:**100**pkt. 2020, submitted to: Scientific Reports. arXiv: `2011.12770 [physics.soc-ph]`.
2. **Kucharski**, R. & Cats, O. *MaaSSim – agent-based two-sided mobility platform simulator* IF:**2.14**, MNiSW:**200**pkt. 2020, submitted to: SoftwareX. arXiv: `2011.12827 [cs.MA]`.
3. De Ruijter, A., Cats, O., **Kucharski**, R. & van Lint, H. *Evolution of Labour Supply in Ridesourcing* IF:**2.214**, MNiSW:**100**pkt. 2020, submitted to: Transportmetrica B.
4. Cats, O., **Kucharski**, R., Danda, S. & Yapp, M. *Beyond the Dichotomy: How Ride-hailing Competes with and Complements Public Transport* IF:**13.11**, MNiSW:**200**pkt. 2020, submitted to: Science Advances.
5. Drabicki A., K. R. & O., C. *Willingness to wait with real-time crowding in urban public transport* IF:**3.693**, MNiSW:**140**pkt. 2020, submitted to Transportation Research Part A: Policy and Practice.
6. Banet, K., **Kucharski**, R. & Naumov, V. *Using city-bike stopovers to identify urban tourism hotspots* IF:**4.147**, MNiSW:**140**pkt. 2020, submitted to Current Issues in Tourism.

Scopus papers

1. Drabicki, A., Kucharski, R. & Szarata, A. Modelling the public transport capacity constraints' impact on passenger path choices in transit assignment models. *Archives of Transport* **43,** 7–28 (2017).
2. Kucharski, R. & Gentile, G. Modeling information spread processes in dynamic traffic networks. *Communications in Computer and Information Science* **640,** 317–328 (2016).
3. Kucharski, R. & Gentile, G. *Observing rerouting phenomena in dynamic traffic networks* in (2015), 140–147.
4. Kucharski, R. & Gentile, G. Indirect observation of rerouting phenomena in traffic networks - Case study of warsaw bridges. *Archives of Transport* **32,** 29–41 (2014).
5. Kucharski, R. & Gentile, G. Direct observation of rerouting phenomena in traffic networks. *Archives of Transport* **30,** 57–66 (2014).
6. Kucharski, R., Kulpa, T., Mielczarek, J. & Drabicki, A. Method to decompose regional travel demand model -case study of kraków region. *Lecture Notes in Networks and Systems* **51,** 114–124 (2019).
7. Kucharski, R., Kostic, B. & Gentile, G. *Real-time traffic forecasting with recent DTA methods* in (2017), 474–479.
8. Drabicki, A., Kucharski, R., Cats, O. & Fonzone, A. *Simulating the effects of real-time crowding information in public transport networks* in (2017), 675–680.
9. Drabicki, A., Szarata, A. & Kucharski, R. *Suppressing the effects of induced traffic in urban road systems: Impact assessment with macrosimulation tools-results from the city of Krakow (Poland)* in. **47** (2020), 131–138.

Please refer to my researchgate and google scholar for a more complete and up to date list.

Research grants and external funds (underlined - PI)

2021-2024 **NCN OPUS 19** 2020/37/B/HS4/01847 - Post-corona shared mobility Modelling and controlling virus spread processes in shared mobility networks. - **PI**

2019-2021 **ERC Starting Grant CriticalMaaS project (grant number 804469)**, financed by the European Research Council and the Amsterdam Institute of Advanced Metropolitan Solutions - **postdoc**.

2018-2019 System informatyczny komputerowego wspomagania planowania komunikacji miejskiej, **NCBiR**, POIR.01.01.01-00-0970/17-00, **researcher**,

2018 Marie Skłodowska-Curie **NCN POLONEZ** UMO-2015/19/P/HS4/04067, **researcher** (PI - Michał Niedzielski - IGiZP PAN),

2016-2018 Zasady prognozowania ruchu drogowego z uwzględnieniem innych środków transportu – realizacja w ramach przedsięwzięcia RID (Rozwój Innowacji Drogowych); DZP/RID-I-62/11/**NCBR**/2016, **researcher**,

2013-2014 Badania zachowań komunikacyjnych mieszkańców Krakowskiego Obszaru Metropolitarnego" - Urząd Miasta Krakowa **researcher**

2013-2015 COST Action scientific missions (7500 eur)

2012-2015 System symulacyjny dla zrównoważonego zarządzania mieszaną elektryczną i spalinową flotą taksówek – **NCBiR** UMOWA Nr PBS1/A6/11/2012, X.2012 – IX.2015, **researcher**.

2012-2014 Plan zrównoważonego rozwoju publicznego transportu zbiorowego w województwie małopolskim, – Urząd Marszałkowski Województwa Małopolskiego, ul. Basztowa 22, 31-156 Kraków - **researcher**

2011-2014 **DOCTUS** Malopolski program stypendialny ZS 4112-55/11 Modelowanie wplywu zachowan kierowcow w sytuacjach incydentow ruchowych, na stan miejskiej sieci transportowej

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Teaching Experience

PhD studies

1. IT systems in transportation
2. Demand modelling in passenger and freight transportation

Graduate and undegraduate studies (Transportation Engineering, Spatial Planning, Civil Engineering)

1. Introduction to Transportation Planning (**in English**) - lecture + project
2. Planowanie Układów Komunikacyjnych - projects + lecture
3. Narzędzia mikrosymulacyjne - projects + lecture
4. Prognozowanie Ruchu - projects + lecture
5. Efektywność Inwestycji i Systemów Transportowych - projects + lecture

6. Planowanie Systemów Transportowych - projects
7. Niezawodnośc i bezpieczeństwo - projects
8. Strategie Rozwoju Transportu - projects
9. Podstawy Planowania Komunikacyjnego - projects - **co-author of the new teaching design script**
10. Planowanie Układów Komunikacynych - projects

Public teaching materials

1. public repository - lectures and slides
2. Podstawy Planowania Komunikacyjnego teaching materials
3. passcounts Showcase of using passenger count data with pandas
4. DataScience for TransportationResearch teaching hands-on tutorial, from raw online data from bike rental to big-data mobility analyses

Teaching Qualification

1. The University Teaching Qualification (UTQ) programme - Supervise - TU Delft, 2020
2. The University Teaching Qualification (UTQ) programme - Develop - TU Delft, 2020
3. Studium Pedagogiczne dla Asystentów i Doktorantów, CPiP Politechnika Krakowska - 2014

PhD cosupervision

Arkadiusz Drabicki (with prof. Oded Cats and prof. Andrzej Szarata)

Master and bachelor theses

1. Drivers' repositioning algorithm and their efficiency with MaaSSim, Daan Knobbe, TU Delft.
2. Spatial distribution of ride-pooling efficiency - case of Amsterdam, Marko Maricic, TU Delft.
3. Study of the accessibility of Lesser Poland voivodeship communes to Cracow by PT, Katarzyna Sliwinska
4. Vulnerability analysis of road network - Bielsko-Biala sase study, Katarzyna Kubica
5. Optimization of Transit network of tourist town, Zakopane case study, Mateusz Pietruch
6. Filling analysis of selected separated car parks in the city of Wrocław, Alexander Pawlowski.
7. Methods to analyze and visualize travel data: Lesser Poland Voivodeship case study, Krzysztof Skrzypek
8. Reproducing Lewis-Mogridge Position with the Four Stage Demand Model, Jan Paszkowski
9. Analysis of travel behavior of BlaBlaCar users in Warsaw-Cracow corridor, Athina Jurkowska
10. Impact analysis of the intensity and parking type on travel time in urban setting - comparison of parallel, perpendicular and angled parking, Jakub Romanczuk
11. Utility analysis of planned expressways for regional and local traffic based on the example of the S19 road in provinces Lubelskie and Podkarpackie, Jan Bielecki
12. AADT change from 2010 to 2015 - case study of Warsaw Agglomeration, Joanna Wieczorek
13. Bus Rapid Lines Scheme Optimization - Case Study of Aleje Korridor in Krakow, Mateusz Kargulewicz
14. Cyclists Travel Time Analysis at Mogilska Rd in Krakow, Maciej Konarzewski
15. Long-term cross analysis of traffic volumes on Warsaw road network, Natalia Boruta
16. Observing Cyclists Queuing Behavior at Signalized Intersections, Klaudia Zylka.

Public scientific repositories

1. **ExMAS** Exact Matching of Attractive Shared rides (`pip install ExMAS`)
2. **MaaSSim** Agent-based simulator for two sided urban mobility markets (`pip install MaaSSim`)
3. **query_ PT** Query public transport connections for a set of trip requests
4. **visum_ to_ pandas** python scripts to parse visum .net and .dmd file to pandas and store as .csv files for further Data Science applications.
5. **st_ cluster** methods to cluster spatio-temporal mobility data with Vectors of Movement.
6. **MOMM** Model ogólny mobilności miejskiej dla miast małych i średnich - do celów dydaktycznych, badawczych i innych
7. **passcounts** Showcase of using passenger count data with pandas
8. **DataScience for TransportationResearch** teaching hands-on tutorial, from raw online data from bike rental to big-data mobility analyses

Remaining scientific track

Editor

1. 6th MT-ITS2019 proceedings in IEEE Xplore. Collection of 91 papers indexed in Scopus.
2. SI in Algorithms journal editor.

Selected talks

1. Oct 2020, MIMUW Seminar, **University of Warsaw**, What constituted transportation engineering as a science
2. Jan 2020, SmartPTlab seminar, **TU Delft**, Exact matching of attractive shared rides
3. Dec 2018, Transp-OR seminar, **EPFL** Lausanne, Rerouting phenomena in Dynamic Traffic Assignment Information Comply Model
4. Sep 2017, PTV Academia, **Karlsruhe**, Modelling rerouting phenomena in Dynamic Traffic Assignment with the Information Comply Model
5. June 2014, **PTV Webinar**, TRE Visum Add-in New dynamic assignment in Visum
6. May 2014, PTV UGM, **Berlin**, TRE Visum Add-in New dynamic assignment in Visum
7. Sep 2012, PTV UGM **Karlsruhe**, From Automatic Plate Number Recognition to OD Matrix with Visum Add-On.

Reviewer

• Journal of Intelligent Transportation Systems: Technology, Planning, and Operations • Transportation Research Part C: Emerging Technologies • Journal of Advanced Transportation • IEEE Access • IEEE Intelligent Transportation Systems Transaction • Modelling Public Transport Passenger Flows in the Era of ITS, Springer 2016 • Promet - Traffic&Transportation • European Journal of Transport and Infrastructure Research • IET Intelligent Transport Systems • MDPI Algorithms, Sustainability, Electronics, Computers.

Conference host

MaaS@AMS - event organised by TU Delft and AMS Institute. Cooridinator of four interactive workshops
MT-ITS 2019 Kraków - 6th International Conference on Models and Technologies for ITS.
Modelling 2018, 2016, 2014 polish benchmark modelling conference.
KoKoNaT 2016, 2015, 2014 polish benchmark student transport engineering conference.

Technical skills

• python • .NET • AWS • SageMaker • ANN • tensorflow • BusMezzo • SQL • GIS • geojson • pandas • scikit • sciPy • BIOGEME • Gurobi • MatSIM • plotly • basic Java • basic `C++` • Scrum • SVN • git • Cplex

Languages skills

Polish (*mother tongue*) • English (*academic proficiency in writing and communication*) • Italian, Russian, German (*restaurant/tourist level*),

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References

Prof. Oded Cats *TU Delft* • Prof. Guido Gentile *La Sapienza* • Prof. Andrzej Szarata *Politechnika Krakowska* • Klaus Noekel *PTV AG* • Travis Nadelhoffer *North Gravity* • Lorenzo Meschini *SISTeMA*
