

Survivability Methods for the Interconnected ICT and Power System

Resilience and Recovery Approaches for the Future Energy Systems

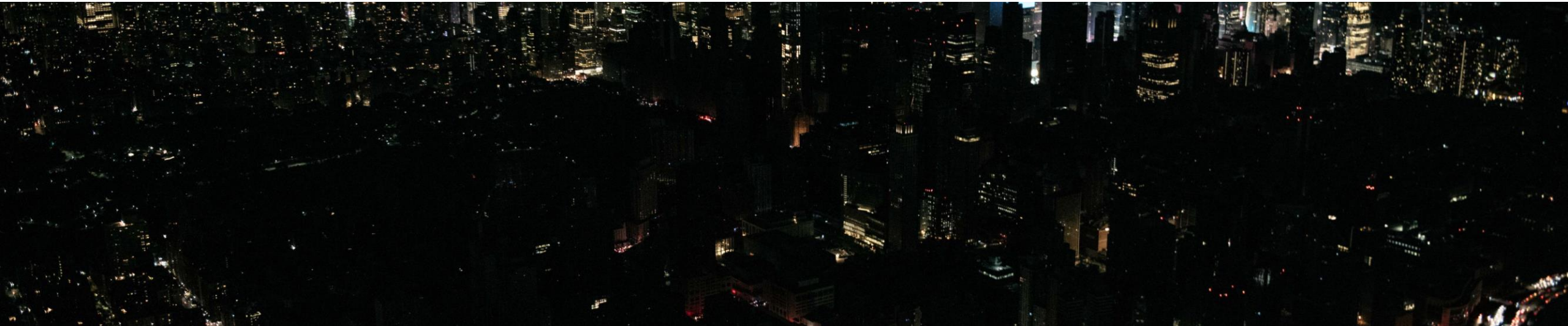


Photo: Scott Heins/Getty Images

Anna Volkova, Prof. Hermann de Meer

Chair of Computer Networks and Computer Communications (CNACC)

Kick-Off Meeting

Anna Volkova

- Email: anna.volkova@uni-passau.de
- Virtual Meetings Preferred
- **Room: ITZ 154**

- The subject of all the emails should start with name of seminar



- Course Number: **6008S**
- Course Type: **Seminar**
- Eligibility: **MA Inf., MA MES**
- ECTS points: 5
- The seminar goals:
 - Familiarize topics of the current scientific research
 - Search for and read scientific materials
 - Propose questions and solve them
 - Write scientific paper
 - Scientific presentation
 - Obtain practical results
- **Number of Topics: 4+2**
- Strong recommendations & Requirements:
 - Knowledge and interest in Power and ICT Systems
 - **Requirement: Foundations of Energy Systems (formerly Computer Networks & Energy Systems) Lecture Participation**
 - Programming skills for practical topics (Python/C++)



Seminar Organization



- Each student will get:
 - One topic to work on during the seminar
 - 1-2 starting references
 - Other literature should be sought out by yourself
 - Keshav, S. "**How to read a paper.**" ACM SIGCOMM Computer Communication Review 37.3 (2007): 83-84.
 - **Hint:** How to read and understand a scientific paper: a guide for non-scientists <http://violentmetaphors.com/2013/08/25/how-to-read-and-understand-a-scientific-paper-2/>
 - Templates for seminar report and presentation
- Scientific literature digital libraries and search engines, for example:
 - <http://scholar.google.de/>
 - <http://ieeexplore.ieee.org/Xplore/home.jsp>
 - <http://acm.org/>
 - <http://citeseerx.ist.psu.edu/>
 - **Hint:** Free access via University network is available for multiple libraries including IEEE (use VPN while the PC-Pool are not available)

- General Requirements
 - You need to virtually **BE here today**
 - This is your **first** (mandatory) seminar in your master studies
 - You need to have **passed** the exam in Foundations of Energy Systems (former RN3 / Computer Networks and Energy Systems)
 - You need to have modelling/research experience for theoretical topics
 - Topics will be assigned according to the order of registration in StudIP seminar



- Topic Assignment is Binding
 - You will have to sign seminar enrollment form
 - Due to the Pandemic, enrollment process is virtual
 - You will receive the form to sign
 - You have to print, sign, scan the form and send it back to both prohdm@uni-passau.de and anna.volkova@uni-passau.de with seminar number 6008S as message subject
 - You have 1 week to send a signed form till 27.09, otherwise the topic you have selected will be not assigned



Seminar Enrollment Form

- Enrollment form will be sent via email after Kick-Off meeting

Anmeldung bzw. Notenmitteilung für Seminararbeit zur Übermittlung an das Prüfungssekretariat Datum: ____16.03.21____

1. Angaben durch die/den betreuende/n Prüferin / Prüfer: _Prof. De Meer_ Sommersemester __21__ / Wintersemester ____

Veranstaltungsnummer: __6008__ genaue Bezeichnung des Seminars: Large-Scale Disturbance-Resilient ICT Systems fort he Smart Grid **Unzutreffende Pnr. bitte streichen**

Bachelorstudiengang		Masterstudiengang		weitere Studiengänge
<input type="checkbox"/> Internet Computing	Pnr. 401390 Seminar	<input type="checkbox"/> Informatik	Pnr. 450001 Pflichtseminar (PO 20161)	<input type="checkbox"/> Lehramt Gymnasium Pnr. 784751
<input type="checkbox"/> Informatik	Pnr. 401320	oder weiteres Forschungsseminar Jeweils 1 x möglich in der jeweiligen Schwerpunktmodulgruppe (PO 20161) nach Einhaltung der sonstigen Regeln der Prüfungsordnung (PO)	Pnr. 451010 Algorithmik und Mathematische Modellierung Pnr. 452010 Informations- und Kommunikationssysteme Pnr. 453010 Programmiermethoden und Softwaresysteme Pnr. 454010 Intelligente Technische Systeme Pnr. 455010 IT-Security and Reliability	<input type="checkbox"/>
<input type="checkbox"/> Mobile und Eingebettete Systeme	Pnr. 446100 Seminar	<input type="checkbox"/> Mobile and Embedded Systems	Pnr. 470001 Pflichtseminar	<input type="checkbox"/>
<input type="checkbox"/> Mathematik	Pnr. 411401 Seminar Pnr. 411402 Proseminar	<input type="checkbox"/> Computational Mathematics der Prüfungsordnung (PO20181)	Pnr. 481001 Pflichtseminar 1 / Pnr. 481002 Pflichtseminar 2 Pnr. 482110 Seminar in Algebra, Geometry and Cryptography Pnr. 482210 Seminar in Mathematical Logic and Discrete Mathematics Pnr. 482310 Seminar in Analysis, Numerics and Approximation Theory Pnr. 482410 Seminar in Dynamical Systems and Optimization Pnr. 482510 Seminar in Stochastics, Statistics	<input type="checkbox"/>

2. Angaben durch die Studierenden: **ACHTUNG: Seminare dürfen bei „nicht bestanden“ / „nicht angetreten“ höchstens zweimal wiederholt werden!!!**

Grau hinterlegte Spalten werden von der Teilnehmerin/ dem Teilnehmer des Seminars gut lesbar in Druckschrift mit der Prüfungsnummer (siehe Aufstellung oben) ausgefüllt. Bei einem Doppelstudium füllen Sie bitte eine zweite Zeile aus, wenn das Seminar dort ebenfalls verbucht werden kann.
Studierende im M.Sc.INF geben mit der Prüfungsnummer (Pnr.) an, ob das Seminar als Pflichtseminar oder als Forschungsseminar abgelegt wird.

Nr.	Name, Vorname	Abschluss B.Sc. oder M.Sc.	Studien- gang IC / INF/ MAT / MES CMT / INF / MES	Prüfungsnummer (Pnr.) Siehe Angaben oben	Prüfungs-Version z. B. 20181	Unterschrift	Matrikelnummer	Note
1								

Insert a number according to your degree and program (see above)

Insert correct examination version (<https://www.fim.uni-passau.de/en/study/examination-regulations/>)

Sign by hand!

- 12-15 pages (including figures, tables, and references)
- Word or Latex Template
 - Will be provided by tutor
 - Submission must be PDF
 - **Don't forget to add your matriculation number!**
- Language: English
- **Hint:** Start writing/drafting your report early, preferably already during the research phase
- **Hint:** Take care about references, use Mendeley/BibTex to collect and accurately cite the related work



- For a scientific output your report has to include:
 - Complete definition, e.g. of the problem you are trying to solve
 - Meaningful figures
 - Concise tables
 - Proper references
 - Clear sentences (avoid redundancy)
- Your report should be Plagiarism-Free (Plagiarism will be graded as 5.0)



- 15-20 min presentation + 10 min discussion
- 8-12 slides (maximum)
 - 2-3 minutes for each slide
 - Animation is not involved
- PowerPoint & LaTeX-Template will be available in Stud.IP
- Simple tips for making slides
 - Use bullet points, instead of long sentences
 - Do not read from slides
 - A figure is better for explanation, but please do not only present figures
 - **Hint:** Prof. S. Keshav. “How to give a talk”.
<http://blizzard.cs.uwaterloo.ca/keshav/home/Papers/data/11/giving-talksv3.pdf>



- Deadlines
 - 20.09.2021 Kick-off (today)
 - 04.10.2021 Guidance for scientific writing
 - 18.10.2021 **Abstract and Research Questions** (ca. 1 page) + Feedback
 - 01.12.2021 **Current progress** (ca. 2-4 pages) + Feedback
 - 10.01.2022 **Final report for peer review** (8-12 pages) + Feedback
 - 17.01.2022 **Draft of slides** for presentation (ca. 8-12 slides) + Feedback
 - 17.01.2022 **Peer review** of final report deadline
 - 06.02.2022 Submission of **final slides** for presentation (ca. 8-12 slides)
 - 07.02.2022 **Presentation**
 - 28.02.2022 Submission of **final report** (12-15 pages)
- **Note:** After each deadline contact your supervisor for feedback!

- Abstract & Research Questions
 - First ideas after starting reference
 - Research direction and question
 - Discuss plan
- Current progress
 - State of work
 - Methodological approach to solve the research question
 - Discuss current issues and next steps
- Final report for review
 - Get feedback
 - Integrate comments



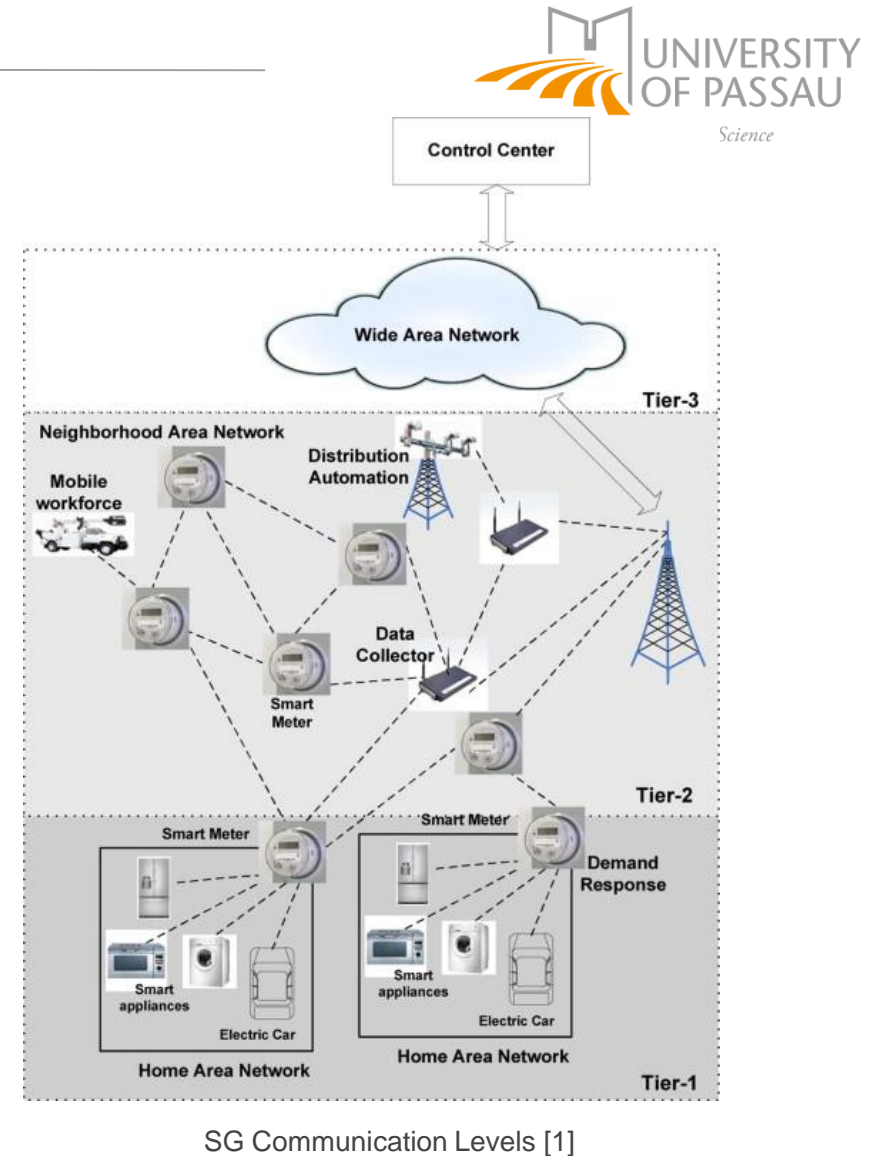
- Review-template will be available in Stud.IP
- Duration: one week
- Prof. S. Keshav “Evaluating a research paper”
http://blizzard.cs.uwaterloo.ca/keshav/wiki/index.php/Evaluating_a_research_paper
- It consists of four main parts:
 - Summary
 - Major strengths
 - Major shortcomings
 - Final evaluation
 - Paper structure
 - Language
 - Overall quality of the paper



Seminar Topics

Topic Set Description

- During the blackout, communication (ICT) system experience severe disturbances, which possibly lead to the unavailability of the wide-area communication.
- In this seminar, we are interested in how to provide the communication to the power grid components and what communication technologies and communication recovery methods can support power grid communication:
 - How to restore wide-area networks?
 - What technologies can bridge the gaps?
 - How to model degradation of the communication system?
 - What resources we can use in such emergency situation?



SG Communication Levels [1]

[1] Saputro, Nico, Kemal Akkaya, and Suleyman Uludag.
"A survey of routing protocols for smart grid communications." *Computer Networks* 56, no. 11 (2012): 2742-2771.

- How to apply progressive recovery methods to the wide-area smart grid communications?
 - How to formulate the optimization problem?
 - What aspects should be considered for the selection of the node to be recovered?
- Task:
 - Review the progressive recovery algorithms and problem formulations
 - Identify different node criticality parameters
 - Formulate the optimization problem for the wide-area power grid communication
 - Setup a simple solver for your problem
- Starting References:
 - Tootaghaj, D. Z., La Porta, T., & He, T. (2019, April). Modeling, Monitoring and Scheduling Techniques for Network Recovery from Massive Failures. In 2019 IFIP/IEEE Symposium on Integrated Network and Service Management (IM) (pp. 695-700). IEEE.
 - Ciavarella, S., Bartolini, N., Khamfroush, H., & La Porta, T. (2017, May). Progressive damage assessment and network recovery after massive failures. In IEEE INFOCOM 2017-IEEE Conference on Computer Communications (pp. 1-9). IEEE.

- How 5G technologies are applicable for the recovery of the wide area communication?
 - How disaster-reliable and adaptable are 5G slices at RAN and WAN level?
 - How to use 5G D2D and relaying to connect remote nodes?
- Task:
 - Study 5G communication features
 - How network slicing, relaying and D2D can be applied for the wide-area emergency scenarios?
 - Propose a 5G-based communication infrastructure which would combine disaster-reliable features
 - Implement a simple scenario using NetworkX simulator
- Starting References:
 - Barakabitze, Alcardo Alex, Arslan Ahmad, Rashid Mijumbi, and Andrew Hines. "5G network slicing using SDN and NFV: A survey of taxonomy, architectures and future challenges." *Computer Networks* 167 (2020): 106984.
 - Ricart-Sanchez, Ruben, Ana Cristina Aleixo, Qi Wang, and Jose M. Alcaraz Calero. "Hardware-Based Network Slicing for Supporting Smart Grids Self-Healing over 5G Networks." In 2020 IEEE International Conference on Communications Workshops (ICC Workshops), pp. 1-6. IEEE, 2020.

- How to model the degradation of the different ICT components during the emergency?
 - What states can ICT components have?
 - How to model the overall network degradation?
- Task:
 - Survey on the degradation models of the cellular, DSL and PLC network
 - Identify the applicable methodology for degradation modelling, e.g. Markov chain or SAN
 - Setup a degradation model for each technology
 - Implement a simple scenario in a simulator (depending on the selected methodology)
- Starting References:
 - Klaes, M., Narayan, A., Patil, A. D., Haack, J., Lindner, M., Rehtanz, C., ... & de Meer, H. (2020). State description of cyber-physical energy systems. *Energy Informatics*, 3(1), 1-19.
 - P. Yong *et al.*, "Evaluating the Dispatchable Capacity of Base Station Backup Batteries in Distribution Networks," in *IEEE Transactions on Smart Grid*, vol. 12, no. 5, pp. 3966-3979, Sept. 2021, doi: 10.1109/TSG.2021.3074754.

Extra Topics

Flexibility modelling for the system



- How to model the flexibility of the heat pumps?
 - What are the different known approaches?
- Task:
 - Survey the heat pumps flexibility modelling methodologies
 - Compare and classify these based on the applicability and used methods
 - Design a simple flexibility model for the given input
 - Evaluate your model on a simple setup
- Starting References:
 - Hong, J., Kelly, N. J., Richardson, I., & Thomson, M. (2013). Assessing heat pumps as flexible load. *Proceedings of the Institution of Mechanical Engineers, Part A: Journal of Power and Energy*, 227(1), 30-42.
 - Jonas Brusokas, Torben Bach Pedersen, Laurynas Šikšnys, Dalin Zhang, and Kaixuan Chen. 2021. HeatFlex: Machine learning based data-driven flexibility prediction for individual heat pumps. In *Proceedings of the Twelfth ACM International Conference on Future Energy Systems (e-Energy '21)*. Association for Computing Machinery, New York, NY, USA, 160–170. DOI:<https://doi.org/10.1145/3447555.3464866>

- Select topic(s) of interest
- Be sure you comply with general requirements:
 - You need to physically **BE here today**
 - This is your **first** (mandatory) seminar in your master studies
 - You need to have **passed** the exam in Foundations of Energy Systems (former RN3 / Computer Networks and Energy Systems)
 - You need to have modelling/research experience for theoretical topics
- Topics will be assigned according to the order of registration in StudIP
- Do not forget to fill and send the enrollment form till 31.03.2021 to both prohdm@uni-passau.de and anna.volkova@uni-passau.de with seminar number 6008S as message subject



#	Topic	Assigned to	Supervisor
1	Progressive Recovery for the Smart Grid Communications	Oussama Smida	Anna Volkova
2	5G Survivable and Emergency Communications	Krunal Ramniklal Sakariya	
4	ICT Degradation Modelling	Pranav Deo	
6	Heat Pumps Flexibility Modelling	Marco Mühl	



Where to start?

- Sign the enrollment form
- Read general literature for the topics:
 - Braun, M., Hachmann, C., & Haack, J. (2020). Blackouts, Restoration, and Islanding: A System Resilience Perspective. *IEEE Power and Energy Magazine*, 18(4), 54-63.
 - Wang, Wenye, Yi Xu, and Mohit Khanna. "A survey on the communication architectures in smart grid." *Computer networks* 55, no. 15 (2011): 3604-3629.
- Review the slides of Computer Networks and Energy Systems to refresh in mind general concepts
- Proceed to your topic-specific references
- Extend your literature review
- Formulate your research questions