SoftNet Experts Panel I

Challenges on Development/Simulation/Validation for Citizen-centric Systems

(man-in-the-middle, self-regulatory systems, cognitive systems, immersive environments, special interfaces, adapted systems life-cycles, system specifications, etc.)

SoftNet/Centric 2021

Panel

Challenges on Development/Simulation/Validation for Citizen-centric Systems

Nowadays, a lot of paradigm shifts lead to " all systems are citizen-centric"

a. Citizen/User (Citizen-centric requirements)
b. Designing (co-design, adaptive design, participative design)
c. Testing/Validation (AI/ML-based for the best coverage and predictive maintenance)
d. End-User (smart user, adaptable/personalized interfaces, requirements refinement)
e. Standardization

Developing citizen-centric systems increases complexity due to additional requirements

- System resilience, Cyber systems protection involve both technical/strategic and human health/well-being requirements.
- System resilience means both technical/strategic and human health/well-being views.
- Request for an approach for increasing test coverage while dealing with continuously changing system complexity.

We are facing a paradigm shift - machines will learn to understand humans

> AI-based systems, Man-in-the-middle-systems, Reflexive systems (adaptable digital twins)
> Then, requirements, V&V, real-time control, and end-user facets of such systems are somehow different versus classical way of developing such systems.

New approaches

> Simulation (Digital twins)
> Testing&Validation (AI-ML)
> Sensing (Internet of Thinks)
> Real-time data collection (Big&Huge Data)
> ... user-oriented empathically data processing (AI-ML, Cognition, Data Protection)

Chair

- Stephan Böhm, RheinMain University of Applied Sciences, Germany

Panellists

- Lisa Taubensee, Advantest, Germany
- Alexander Kröner, Technische Hochschule Nürnberg Georg Simon Ohm, Germany
- José Mario De Martino, University of Campinas, Brazil
- Stefan Bosse, University of Bremen, Dept. of Mathematics & Computer Science, Germany
- Herwig Mannert, University of Antwerp, Belgium

Topics for discussion: (Moderator: Stephan Böhm)

- Lisa Taubensee → Today's Complexity requires validation automation by a machine-learning based tool
- Alexander Kröner → User interfaces should take into account the impact of adaption on intelligibility
- José Mario De Martino → Machine translation strategies devised to translate text can be applied to translate written language to sign language
- Stefan Bosse → Machine Learning as a tool can improve modelling and simulation of citizen-centric systems, e.g., by creating synthetic (augmented) data or using Digital Twin methodologies
- Herwig Mannert → As Citizen-centric systems will become omnipresent, Open Standards and Data Ownership strategies are needed

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Chair Position

AI results in a paradigm shift through more intuitive, adaptive and natural language-oriented UI

Stephan Böhm, RheinMain University of Applied Sciences, Germany stephan.boehm@hs-rm.de

- New machine learning techniques make it possible to offer innovative user interfaces that understand natural text and speech
- Especially in citizen services, people no longer have to follow the rigid grid of forms and input masks
- Systems such as voice assistants and chatbots are available 24/7 and can capture user intents and needs more independently of formalization
- Valuable human consultation time can be used more efficiently when staff are relieved of standard inquiries
- At present, however, such systems are often error-prone and still in their infancy
- The design, development and maintenance efforts to implement efficient systems are often underestimated

→ In the future, humans will have to adapt and prepare less to the requirements of machines for efficient HCI/HMI

→ We are facing a paradigm shift - machines will learn to understand humans

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SoftNet 2021

Panelist Position

Today's Complexity requires automation by a machine-learning based tool

Lisa Taubensee, Advantest GmbH, EU lisa.taubensee@advantest.com

- New Post Silicon Validation methodology and tools
- Linking pre and post silicon
- Leveraging machine learning for validation and debugging
- Leveraging automation throughout the validation process
- Finding unexpected dependencies

→ Traditional methods don't hold for modern complex devices

→ Machine learning provides the most efficient tuning

→ Know your device including complex hidden interactions

Panelist Position

Intelligibility for Adaptive User Interfaces

Alexander Kröner, Technische Hochschule Nürnberg Georg Simon Ohm, Germany alexander.kroener@th-nuernberg.de

- Adaptation of user-interfaces is highly desired in order to tailor user experience to an individuals' situation
- Effects of situational adaption are hardly to predict for user interface developers
- Explanation (before, during, after interaction) of adaptive behavior is a burden to the user
- Eventually, adaptive behavior may reduce usability and increase errors during interaction with an application

User interfaces should take into account the impact of adaption on intelligibility

→ Methods for assessing situated intelligibility of a user interface are needed

→ Adaptive user interfaces require strategies for preserving and improving intelligibility

→ Such knowledge has to be made available for system developers as well as autonomous systems

Panelist Position

Machine Translation from Text to Sign Language

José Mario De Martino, University of Campinas, Brazil martino@unicamp.br

- Sign Language Basics
- Written representation of a Sign Language
- Machine translation strategies
- Signing Avatars

➢ Machine translation strategies devised to translate text can be applied to translate written language to sign language.

SoftNet Experts Panel I

Challenges on Development/Simulation/Validation for Citizen-centric Systems

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Panelist Position

The Reality Gap in Simulation: Reality is correct, but Sensing is wrong. Simulation is mostly wrong, but Sensing is correct!

Stefan Bosse, University of Bremen, Dept. Mathematics & Computer Science EU/GER sbosse@uni-bremen.de

- Modelling of large-scale population-centric systems is a challenge
- Sensing of population data is highly distorted by bias, noise, and varying or unknown test conditions
- As well modelling as simulation rely on reliable, representative, and calibrated data bases!
- Simulation is mostly over-simplified and simulation results do not match real-world developments
- Variance on entity (human) level is not covered by modelling and simulation but has a significant impact on system level

→ Machine Learning as a tool can improve modelling and simulation of citizen-centric systems

→ Machine Learning can be used to create synthetic (augmented) data

→ Digital Twin methodologies can close the gap between real and simulation worlds

IARIA

SoftNet Experts Panel I

Challenges on Development/Simulation/Validation for Citizen-centric Systems

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Panelist Position

Data Challenges for Citizen-centric Systems: Open Standards and Data Ownership

Herwig Mannaert, University of Antwerp, EU-BE

- Growing amount of e-government systems for taxes , licenses, healthcare, …
- Lots of other information systems contain – often related – data of citizens:
  - Electronic Health Records, private practitioners, employers, suppliers, HR companies, …
- Citizen-centric systems require open standards integration and privacy management:
  - Integration based on open standards between various systems.
  - Full data ownership by citizens acting as self-sovereign identities.
  - Governments need to facilitate instead of imposing centralized control.

→ Citizen-centric systems will become omnipresent

→ Strategies for integration and data ownership are needed

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Panel 1

Challenges for Citizen-Centric Systems

DETAILED POSITION

Open Standards and Data Ownership

HERWIG MANNAERT

OCTOBER, 2021

Universiteit Antwerpen

Citizen data is scattered all around …

- Various *e-government systems* for citizens
  - Tax system(s)
  - Health system(s)
  - Driver systems
    - *Driver's license*
    - *Traffic fines*
  - Social security systems
  - Pension systems
  - Visa systems
  - …

Citizen data is scattered all around …

- Various *private administrative systems* for citizens
  - Insurance systems
    - Health
    - Housing
    - Pension
    - Cars
  - Employment systems
    - Employers
    - Payroll services
  - Education systems
  - …

Citizen data is scattered all around …

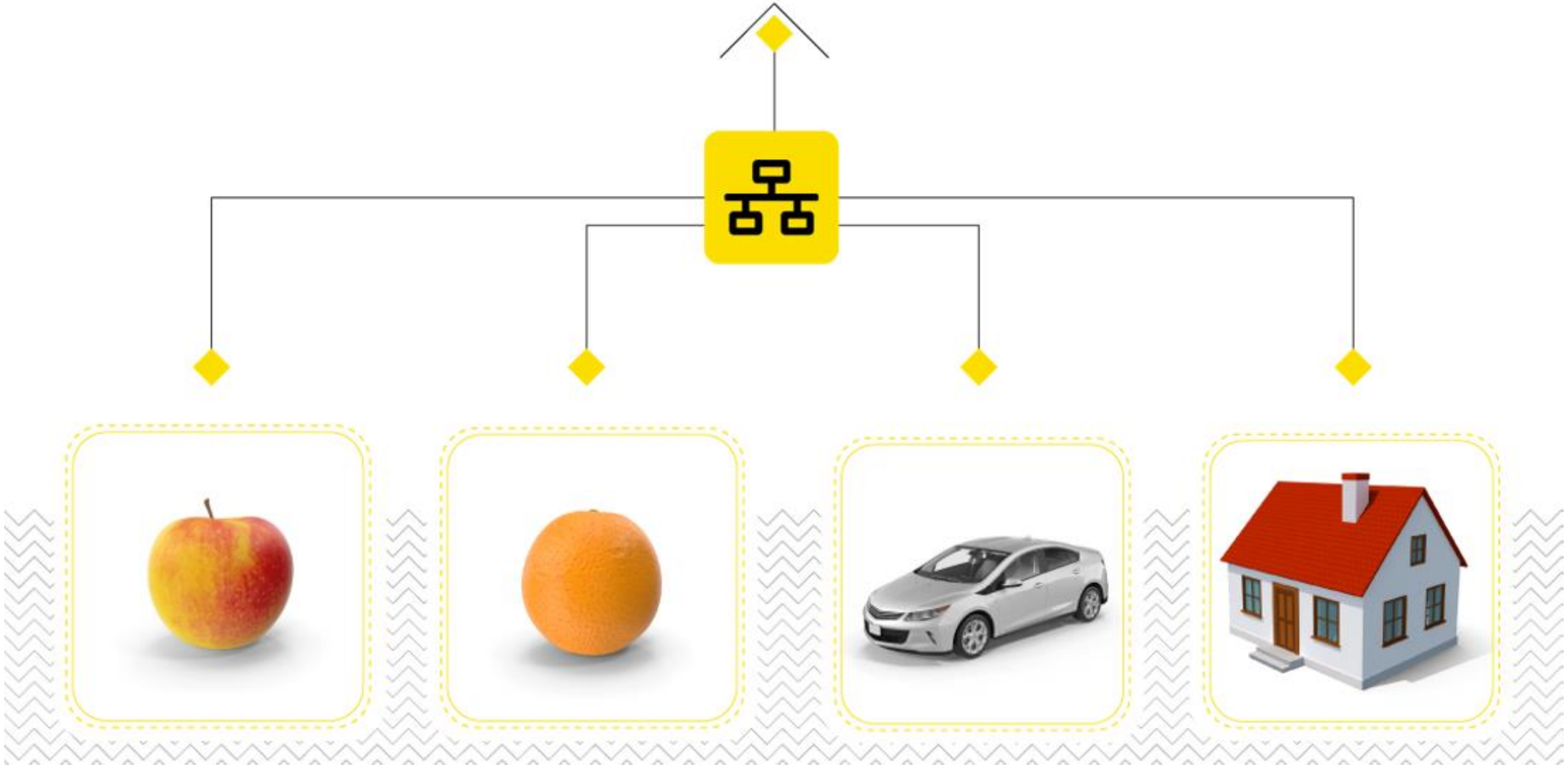
- Various *healthcare information systems* for citizens
  - E-Health system(s) government
  - Electronic Health Record hospital(s)
  - Information system physician(s)
  - Information system dietician(s)
  - Information system physiotherapist(s)
  - Information system psychiatrist(s)
  - Information system pharmacist(s)
  - …

Need for Open Standards – Technically

- Systems need *technical open standards* for integration:
  - e.g., HTTP, XML, REST, JSON, Swagger, OAuth2, …

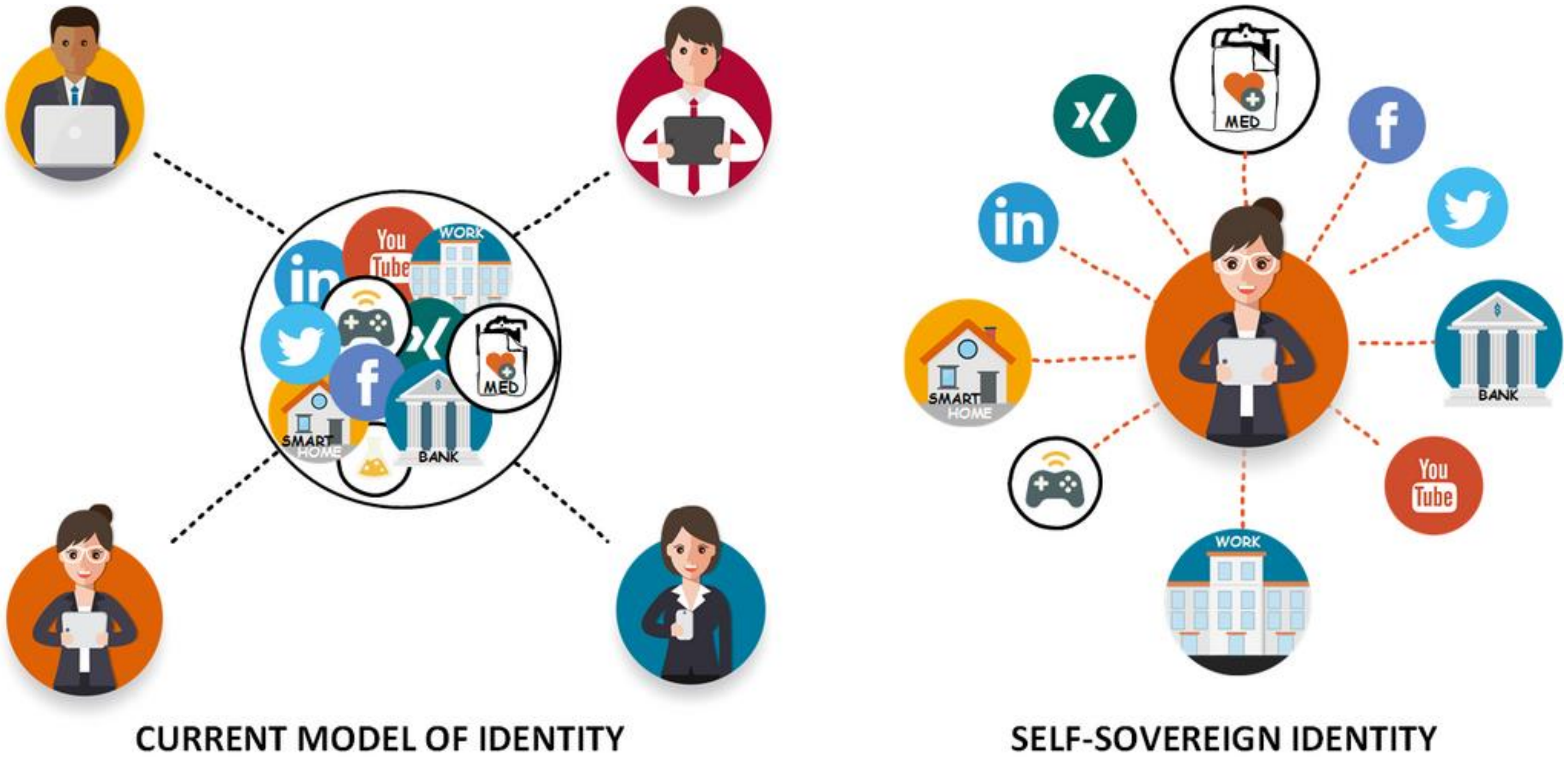
Need for Open Standards – Semantically

- Systems need *semantic open standards* for integration:
  - semantic web of linked data with trust and context-based consent
    - e.g., Open Standards for Linking Organizations – OSLO



Data Ownership – Self-Sovereign Identities

- Citizens need to become *self-sovereign identities*:
  - taking ownership of their own data with decentralized governance
  - deciding who can have access to which data based on their own interests



Conclusion – Need for Standards & Ownership

- Citizen-centric information systems:
  - will become omnipresent in life
  - manage citizen data in a scattered way
- Citizens need seamless integration of data:
  - at a technical level
  - at a semantic level
- Citizens need ownership of their own data:
  - decentralized data governance
  - self-sovereign identities

QUESTIONS ?

herwig.mannaert@uantwerp.be

Panellist Position

The Reality Gap in Simulation: Reality is correct, but Sensing is wrong. Simulation is mostly wrong, but Sensing is correct!

Stefan Bosse, university of Bremen, Dept. Mathematics & Computer Science EU/GER sbosse@uni-bremen.de

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→ Digital Twin methodologies can close the gap between real and simulation worlds

Sensing the Real World

- Modelling is typically the process of abstraction of large-scale multi-entity systems: $M(x): x \rightarrow y$ and $M^{-1}(y): y \rightarrow x$
- Data-driven Modelling of real world systems requires:
  - Planned and participatory experiments delivering aggregated data, and/or
  - Sampling of population and entity data (participatory, opportunistic/ad-hoc)
- Sensing of real-world data can be highly distorted by:
  - Bias (preferences, e.g., politically or socially based, wrong a-priori knowledge)
  - Sampling strategy and sampling distribution
  - Random and systematic errors, statistics (small N)
  - Distortion both in longitudinal (horizontal) and spatial (vertical) dimension

Simulation

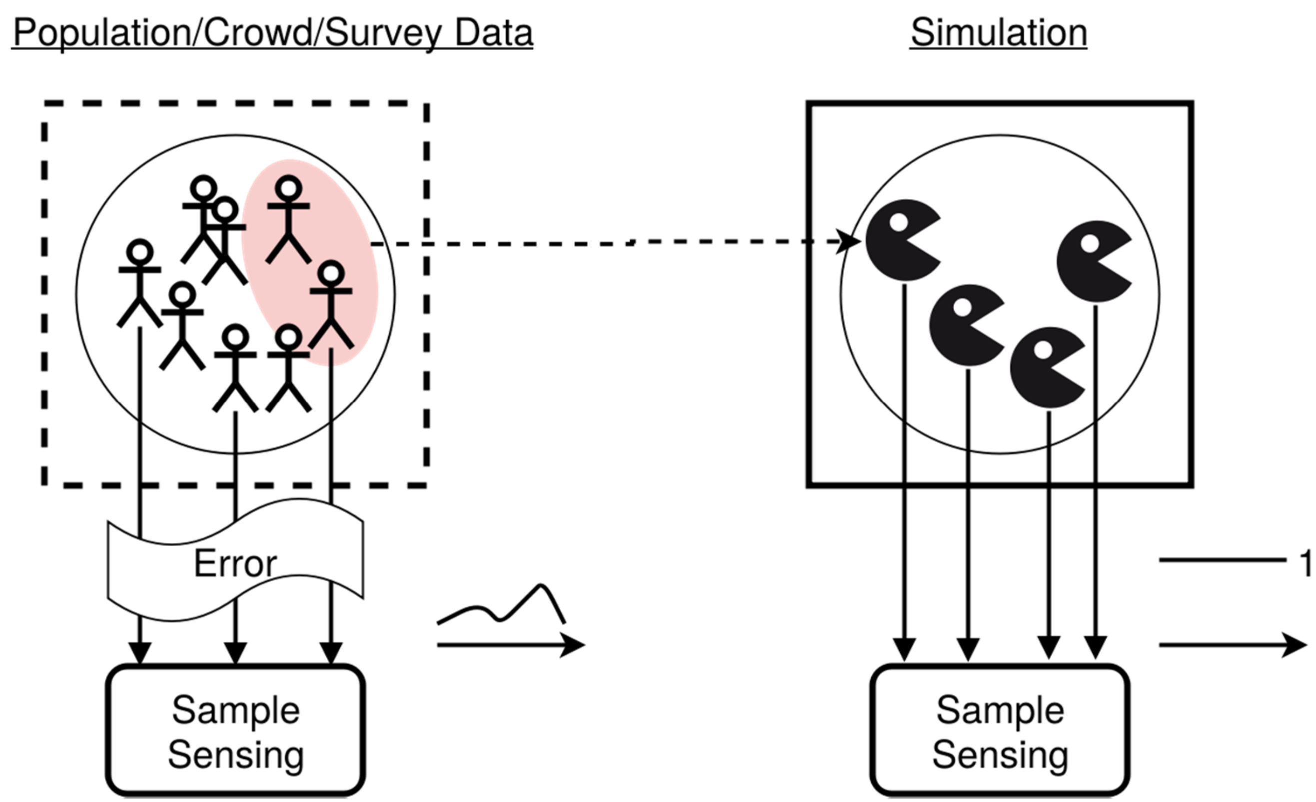
- If there is no closed model $M(x)$: $x \rightarrow y$ that can be derived analytically, simulation can be used to study the effect of x on y.
- Test and probing replaces functional modelling (approximation by measurement)
- Simulation is typically another abstraction of complex worlds
- A simulation model S typically bases on a large number of interacting entities s_i (cells in CA, Agents, Finite-Element Methods, etc.), $S=\{s_i\}_i$
- The entity behaviour model is typically parameterized, $s(p_s)$, creating parameterized behaviour classes $C=\{c_j(p_c)\}_j$
- The simulation world (spatial context, number of entities, partitions) is parameterized, too, $W(p_w)$

Sensing in Real World and Simulation

- Random sampling allows us to make powerful inferences about populations
- Randomness is also crucial to performing experiments well.
- In real world, the sampling coverage distribution is either known (surveys) or unknown (crowd/population data) and always << 100%, there is a (significant) sampling error
- In Simulation, sampling has a 100% coverage and the sampling distribution is uniform → No sampling and sensing error!
  But: Simulation sensors depend on simulation model accuracy depending on real-world data!

Sensing in Real World and Simulation

- Difference between real world and simulation world



Stefan Bosse - The Reality Gap in Simulation: Reality is correct, but Sensing is wrong. Simulation is mostly wrong, but Sensing is correct!

Data-Driven Approach

- Modell and simulation parameter *P* are typically base on experiments or data collected from the real word (population or survey data)
- **Any bias and distortion of the measured data has an impact on the model and simulation parameter and on the model accuracy!**
- **Estimation of the parameter set**

$$\tilde{P}(D') \neq P(D), \tilde{P} = P(D) + error(D'), D' \subset D$$

- A parameter is a value that describes a characteristic of an entire population, such as the population mean → Not directly observable!
- Statistical models perform averaging of variance observed in real world → **Oversimplification, Suppression of important single events**
- Inferential Statistics is highly effected by data bias, outlier, and sample distribution issues!
- **Error Accumulation and Amplification!**

Worst Case Example: Pandemic Data

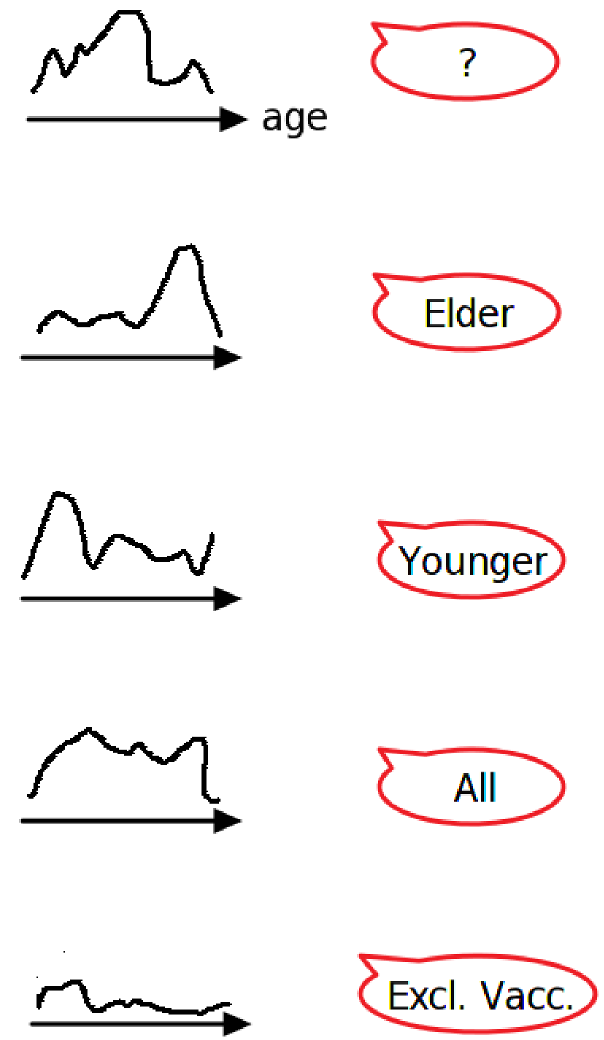
- In pandemic situations there is typically a domestic and centralized collection of infection cases *ic* → population data
- But this is not a typical sampling process; the observable *ic* can result from a mix of data sources:
  - Diagnostics of an infection by symptoms and with or w/o disease (indirect diagnosis)
  - Diagnostics of an infection by laboratory tests (direct diagnosis) with or w/o symptoms/disease/reason
  - "Diagnostics" of an infection by field test w/o reason
- **The observable depends on time, spatial, social, political, and personal context! Calibration of population data nearly impossible!**

Robert Koch Institute

Age stratification: 5 year intervals

Year and week of notification	A00..04	A05..09	A10..14	A15..19	A20..24	A25..29	A30..34	A35..39	A40..44	A45..49	A50..54	A55..59	A60..64	A65..69	A70..74	A75..79	A80+	Unknown
2020-w09	3	1	1	6	13	19	24	9	15	9	14	10	7	8			1	
2020-w10	9	10	20	46	72	79	72	69	86	100	134	77	65	25	11	24	19	
2020-w11	37	57	102	182	323	550	538	553	569	753	982	755	429	237	146	113	135	2
2020-w12	150	174	257	541	1456	2007	2056	1757	1805	2106	3097	2599	1600	884	620	571	788	11
2020-w13	263	261	391	949	2275	2708	2654	2403	2339	2940	4029	3610	2536	1656	1334	1406	2443	7
2020-w14	283	302	439	1086	2261	2500	2437	2227	2333	2740	3746	3691	2797	1696	1418	1792	4594	4
2020-w15	252	243	316	870	1745	1951	1765	1676	1689	1941	2631	2627	1800	1123	1043	1321	4396	3
2020-w29	141	139	147	193	300	310	300	255	253	232	209	178	111	71	63	44	89	1
2020-w30	161	153	193	246	377	412	382	359	321	334	293	243	152	84	63	57	102	1
2020-w31	157	199	252	366	521	511	427	383	433	387	353	288	151	86	90	71	172	3
2020-w32	188	286	364	546	747	607	517	516	490	458	415	308	205	121	91	55	137	18
2020-w33	276	411	545	741	1160	840	708	644	639	574	473	327	193	110	79	71	162	6
2020-w34	286	383	575	884	1546	1193	948	762	718	694	560	431	237	122	97	67	105	2
2020-w35	223	353	483	837	1330	1224	861	716	659	606	538	357	243	129	93	69	111	4
2020-w36	227	318	434	769	1248	1162	939	646	647	613	553	394	251	127	105	75	109	7
2021-w31	764	1156	1491	2374	2794	2406	2076	1594	1448	1177	976	787	475	283	173	122	325	5
2021-w32	1234	1840	2604	3508	4436	3593	3047	2448	2352	1949	1643	1244	711	403	298	228	507	9
2021-w33	1866	3720	5364	5575	5785	5032	4384	3768	3758	3095	2532	1802	977	593	392	287	656	19
2021-w34	2963	5596	6917	6970	6881	6326	5979	5266	5184	4109	3330	2401	1483	810	617	412	1035	25
2021-w35	3422	7012	8405	7779	6831	6300	6583	6000	5696	4624	3724	2711	1832	994	741	540	1450	29
2021-w36	3505	6591	7734	6845	6234	6055	6224	5792	5423	4540	3687	2889	1876	1111	819	591	1693	37
2021-w37	2848	5862	7300	5638	4941	4896	5099	4813	4443	3792	3330	2600	1715	1052	756	571	1708	29
2021-w38	2230	5038	6037	4451	3933	3952	4396	4066	3719	3177	2782	2394	1583	931	673	539	1395	60

Sample Distribution

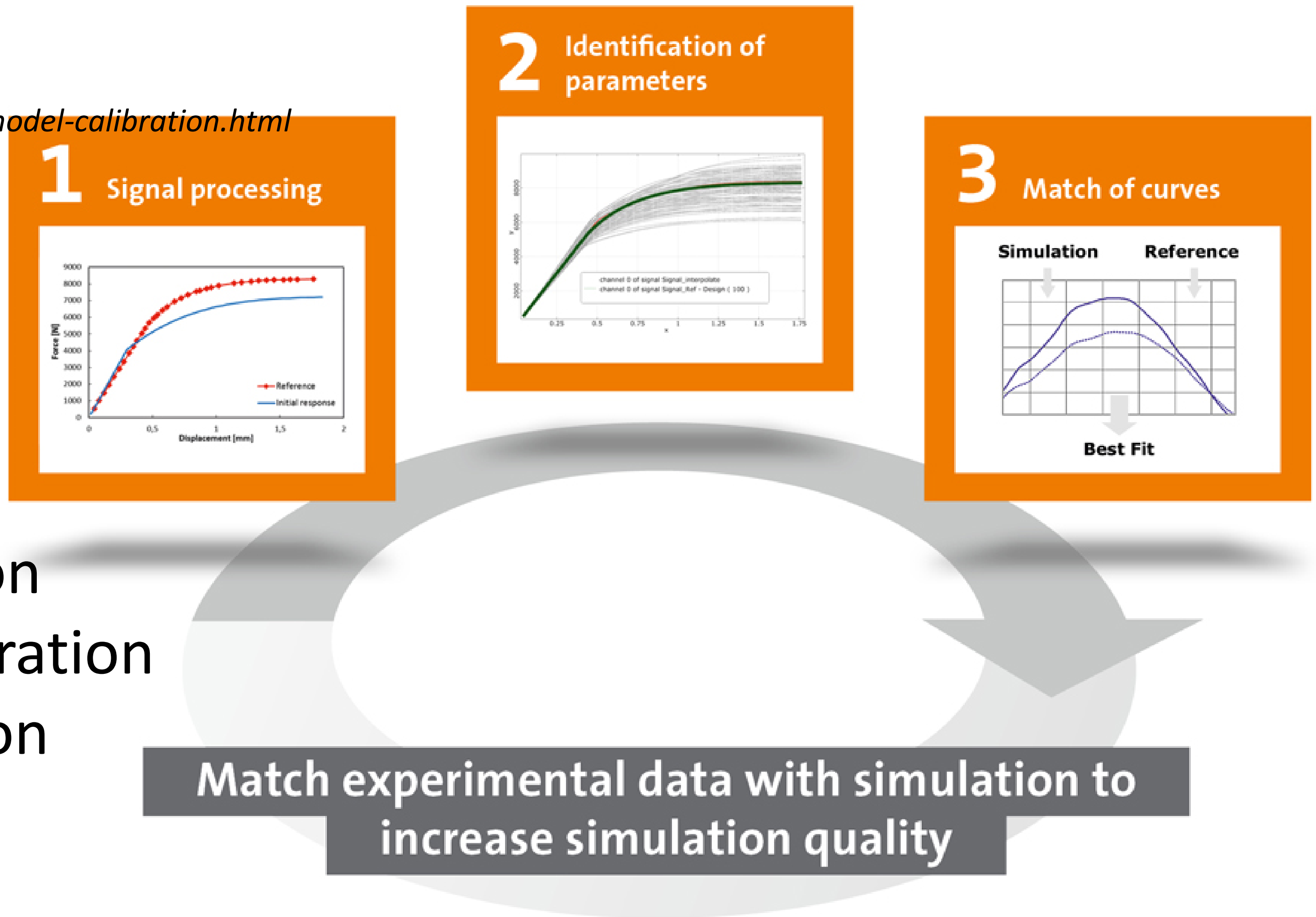


https://survstat.rki.de/Content/Query/Create.aspx

Stefan Bosse - The Reality Gap in Simulation: Reality is correct, but Sensing is wrong. Simulation is mostly wrong, but Sensing is correct!

Calibration

https://www.dynardo.de/en/rdo/model-calibration.html

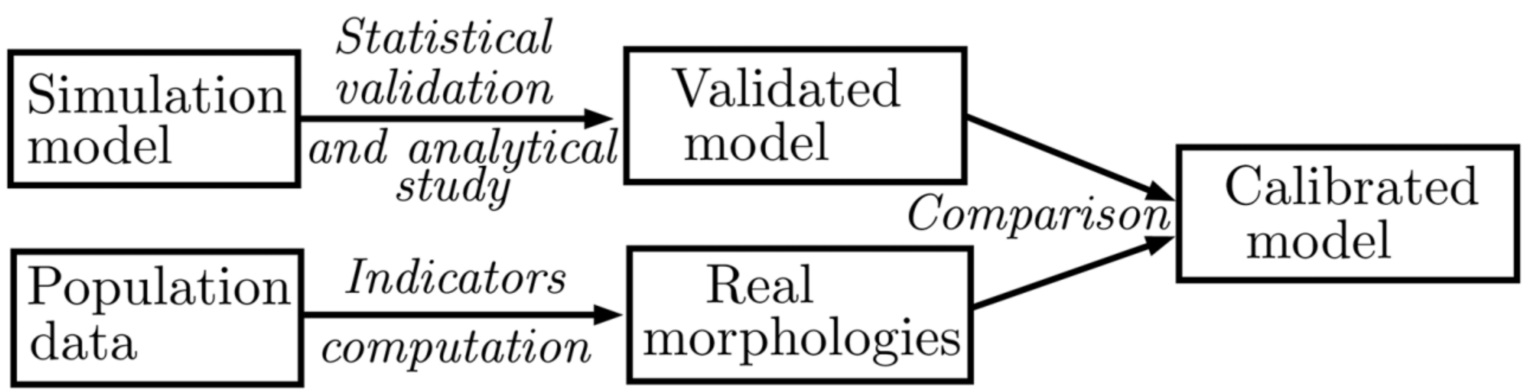


- Model calibration
- Simulation calibration
- Sensor calibration

Calibration

- *Simulation + Population Data*

Raimbault J (2018) Calibration of a density-based model of urban morphogenesis. PLoS ONE 13(9): e0203516. https://doi.org/10.1371/journal.pone.0203516



Calibration

- **<u>Auxiliary variables</u> and statistical models/distributions are required to calibrate population crowd and survey data!**

Changbao Wu & Randy R Sitter (2001) A Model-Calibration Approach to Using Complete Auxiliary Information From Survey Data, Journal of the American Statistical Association, 96:453, 185-193, DOI: 10.1198/016214501750333054

Kim, I., Kim, HC., Seo, DJ. et al. Calibration of a transit route choice model using revealed population data of smartcard in a multimodal transit network. Transportation 47, 2179–2202 (2020). https://doi.org/10.1007/s11116-019-10008-8

- Auxiliary variables and aux. models can be derived from real-world or simulation data
- Analytical inaccessible variables and models can be approximated by Machine Learning → **Surrogate Modelling**!
- **But Simulation and Surrogate Modelling relies again on real-world data!?**

ABS and Surrogate Modelling

- Surrogate Modelling using Machine Learning can calibrate and validate Agent-based Simulations (ABS)

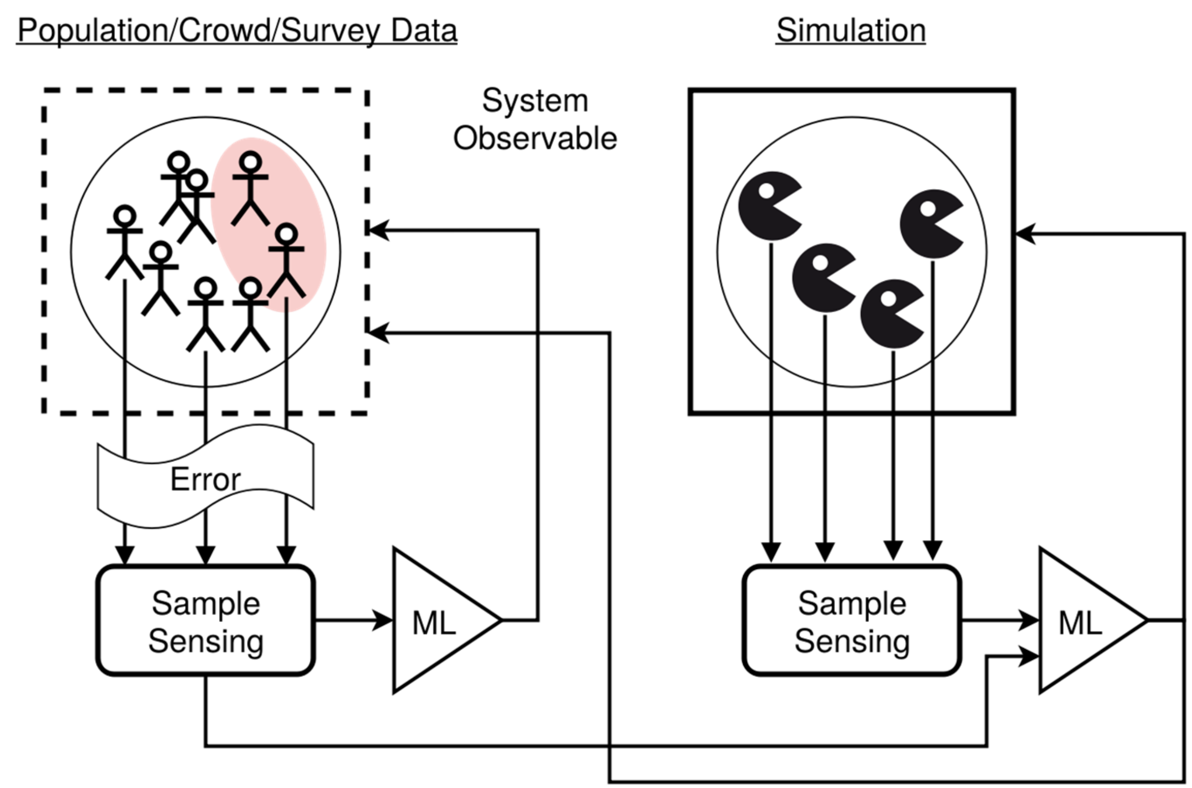
F. Lamperti, A. Roventini, and A. Sani, "Agent-Based Model Calibration using Machine Learning Surrogates."

Y. Zhang, Z. Li, and Y. Zhang, "Validation and Calibration of an Agent-Based Model: A Surrogate Approach," Discrete Dynamics in Nature and Society, 2020.

- **But ML performs again statistical averaging; individual entity/agent behaviour effecting system observables are suppressed**
- **Digital Twin Methodologies introducing parameter variances derived from real-world data are required to increase simulation accuracy!**

Surrogate Modelling

- The aim of surrogate modelling using Machine Learning is to map population data and parameters on system observables
- Complex Task
- Error prone
- Mismatch between real-world and simulation models!
- ML models not transferrable between RW & SIMU!
- Is this correct?
- Loss of individual variance?
- Calibration again needed!



Stefan Bosse - The Reality Gap in Simulation: Reality is correct, but Sensing is wrong. Simulation is mostly wrong, but Sensing is correct!

Summary

- Sensing of population data in real-world is highly inaccurate (even if there are planned sample distributions like in surveys)
- Sensing in simulations is always accurate but not correct due to the simulation dependency on real-world data
- Calibration is a bi-directional process between real-world and simulation data and error prone, too.
- Statistical models (ML) tend to average population behaviour suppressing individual entity behaviour that can have important impact on system observables

Machine Translation from Text to Sign Language

Prof. Dr. José Mario De Martino
University of Campinas, Brazil
martino@unicamp.br

Prof. Dr. José Mario De Martino

martino@unicamp.br

Current Professional Appointments

- Associate Professor at the School of Electrical and Computer Engineering of the University of Campinas, Brazil.
- Coordinator of the High-Performance Computing and Visualization Laboratory Galileu, University of Campinas.
- Member of the Scientific Advisory Board of the Samsung Research and Development Institute for Computer Science, Brazil.
- Member of the Curator Council of the Association for the Promotion of Excellence in Brazilian Software, Campinas, Brazil.

Education

- B.Sc., M.Sc., and Ph.D. in Electrical Engineering, University of Campinas.

Main Areas of interest

- Computer Graphics, Computer Vision, Image Processing, Machine Learning, and Assistive Technology.

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Machine translation from Text to Sign Language

- The fundamental hypothesis of our machine translation from text do sign language strategy is:
  - *State-of-the-art machine translation techniques between written languages can be successfully applied to translate text to sign language*.

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Sign Language Basics

The sign language of a country is independent of its oral/written language.

Examples of English-speaking countries


British Sign Language - BSL


American Sign Language - ASL


Australian Sign Language - Auslan

Examples of Portuguese-speaking countries


Portuguese Sign Language - LGP


Brazilian Sign Language - Libras

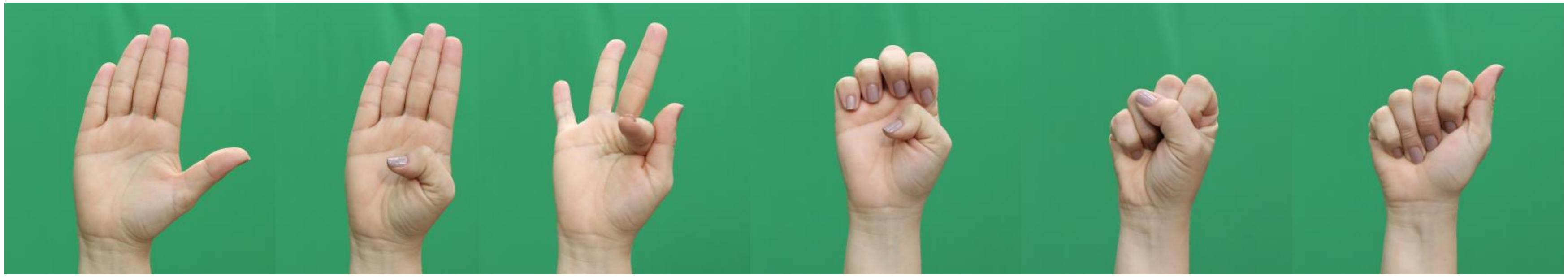

Angolan Sign Language - LGA

Sign Language Basics

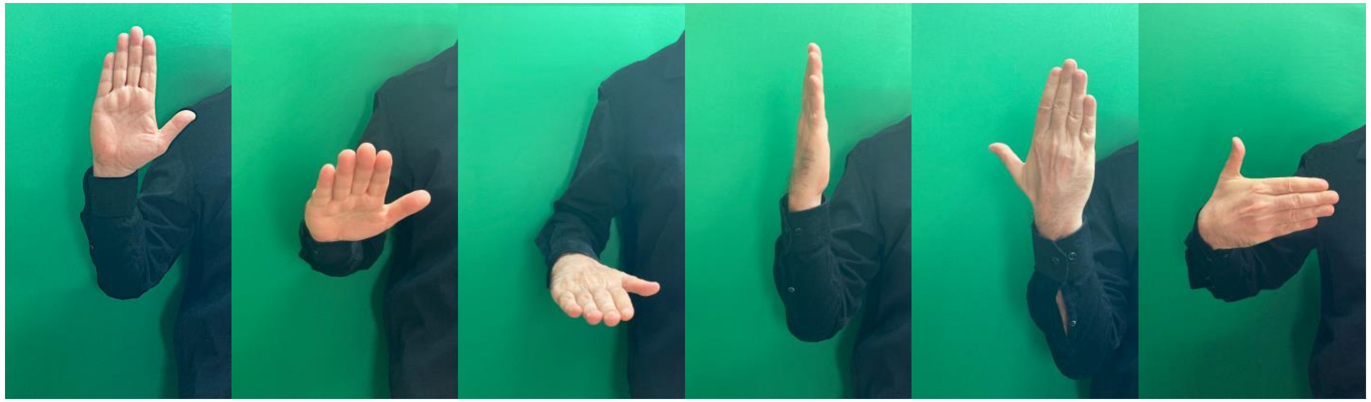
- The contrastive visual units of Sign Languages:
  - Handshape
  - Hand Orientation
  - Location
  - Movement
  - Non-manual expression
- Combinations of these parameters produce signs.

Sign Language Basics

Handshape

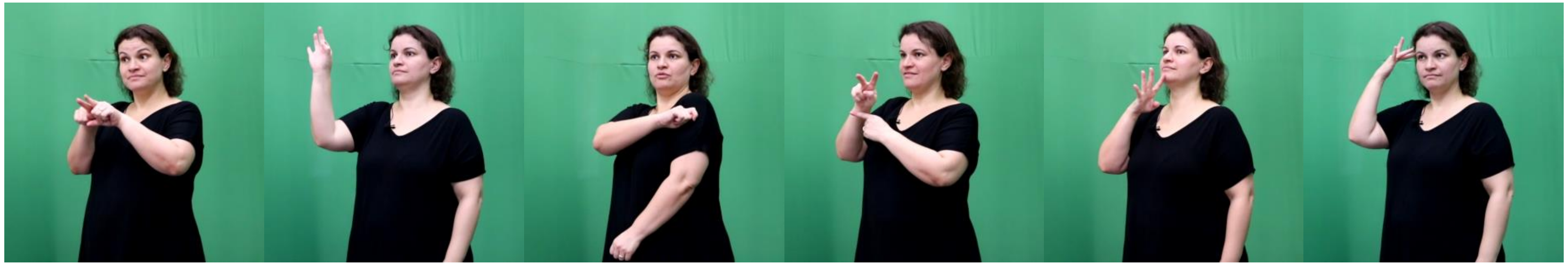


(Palm) Orientation



Sign Language Basics

Location



Sign Language Basics

Movement
(Local)

Movement
(Global)

Sign Language Basics

Non-Manual Expression
(Face and Body)

Non-Manual Expression are used to convey linguistic information and emotions.

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Written Representation of Sign Languages

- There is no widely accepted written representation for sign languages.
- Some relevant writing/notation systems
    - HamNoSys (Hamburg Sign Language Notation System)
    - SignWriting
    - Glossing

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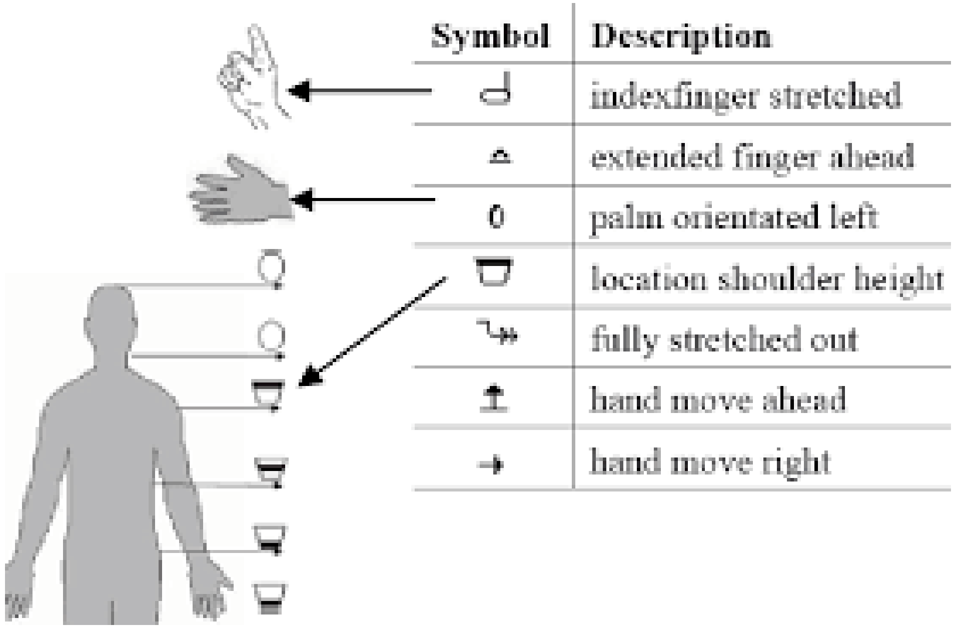
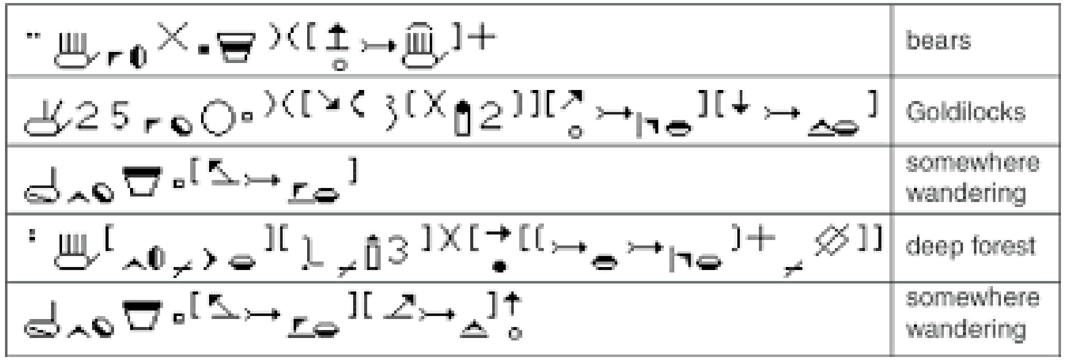
Written Representation of Sign Languages

- HamNoSys is phonetic oriented.
- The iconic symbols of the notation reflect articulatory aspects of sign production.





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Written Representation of Sign Languages

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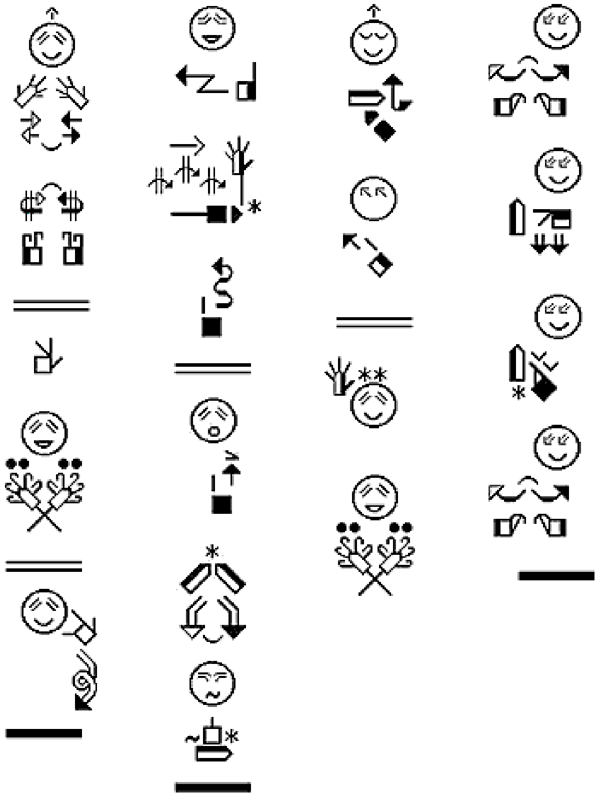


Written Representation of Sign Languages

- Glossing is an annotation strategy that uses words and parts of words of a written/oral language to give information about the meanings and grammatical properties of the signs.
- A simple example

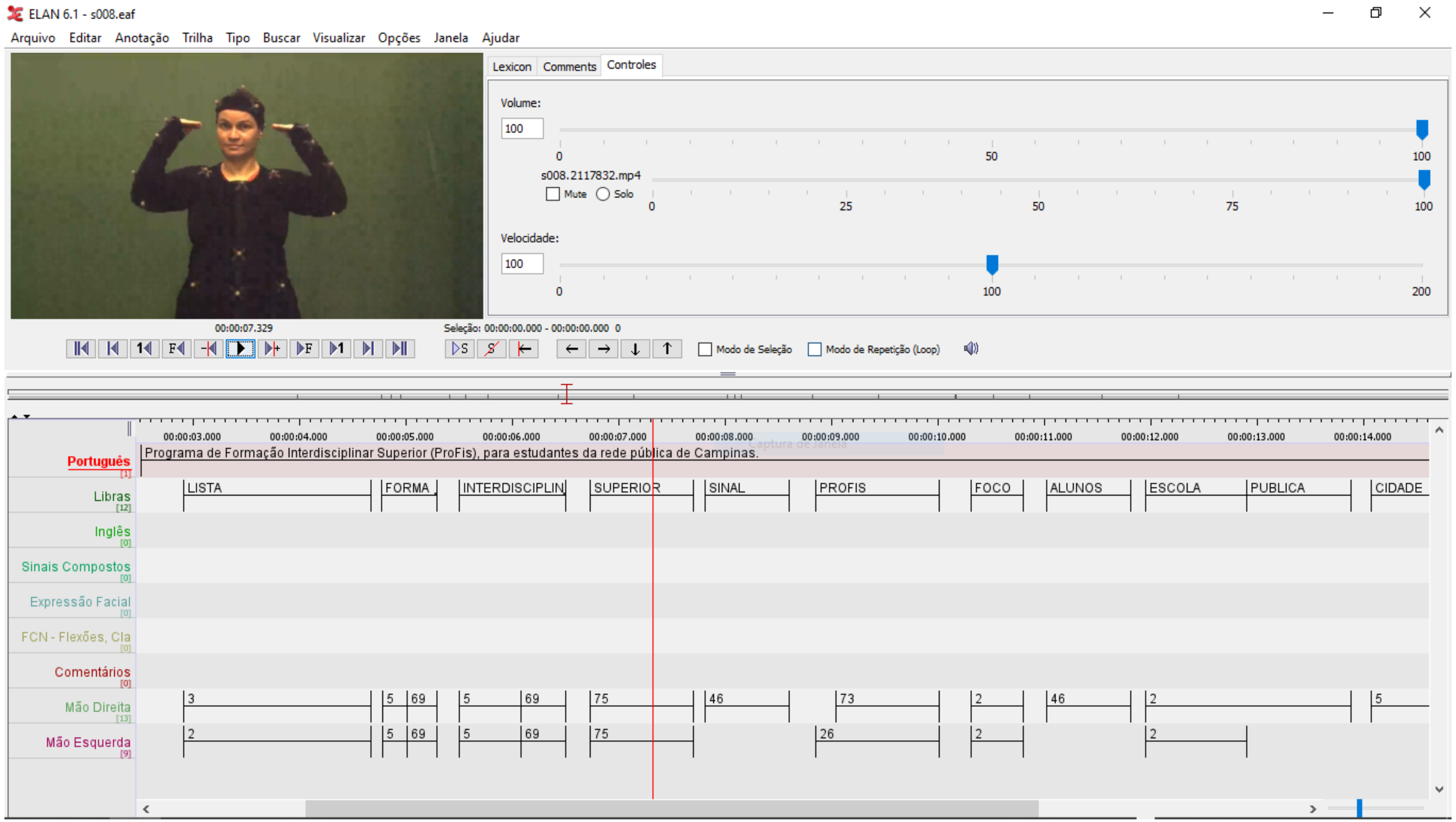
English:	I went to the football game Friday night.
ASL:	FRIDAY NIGHT FOOTBALL GAME I GO

Written Representation of Sign Languages

- Elan is frequently used for glossing sign language productions.

- Elan is an annotation tool for audio and video recordings developed and maintained by the Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands.

Written Representation of Sign Languages



Elan - Screenshot

Machine Translation Strategies

- Machine Translation seeks to carry out, without human interference, the translation from one natural language to another using computers.
- Developments involving machine translation have focused on translation between spoken/written languages.
- There are two basic approaches:
  - Rule-based translation (knowledge-driven);
  - Corpus-based translation (data-driven).

Machine Translation Strategies

- Rule-based translation:
  - requires the explicitation and prioritization of translation rules, including exceptions, from one language to another;
  - is highly dependent on expert knowledge and on consolidated (normative and descriptive) grammars.

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Machine Translation Strategies

- Corpus-based translation:
  - is based on the analyses of paired productions in both languages (parallel corpus);
  - seeks to learn translation patterns from the corpus.
- Currently, Neural Machine Translation is recognized as the state-of-art approach for machine translation.

Machine translation from Text to Sign Language

- To apply known state-of-the-art neural machine translation techniques to translate text to sign language, it is required:
  - a written and computer-processable representation of the sign language;
  - a way to present the translation result in its visual form – that is in sign language.
- A flexible way to present the translation result in sign language is the use of realistic signing avatars.

Signing Avatar

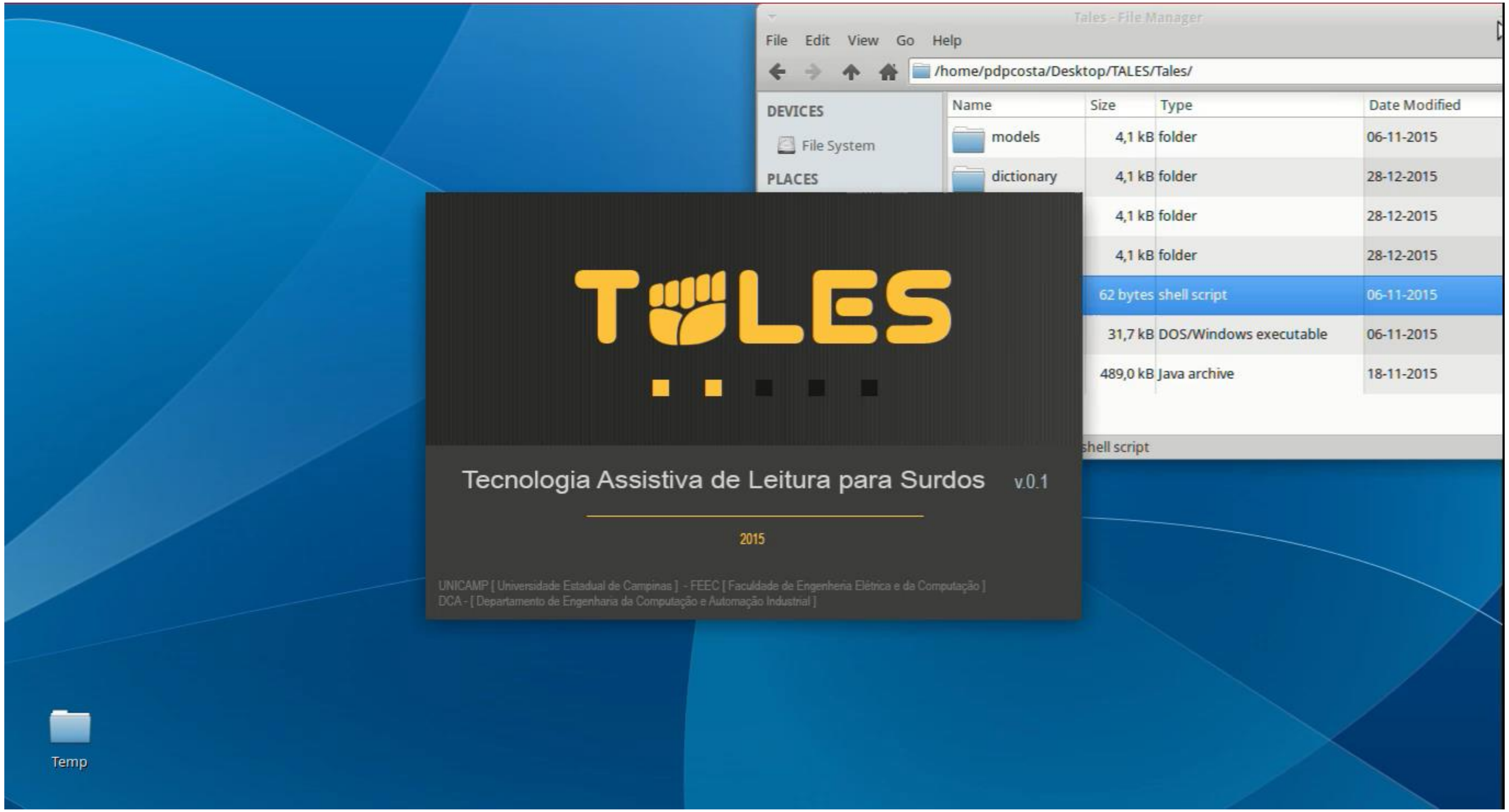
- A signing avatar is virtual anthropomorphic character capable of conveying sign language messages.
- Ideally , a realistic signing avatar is a virtual character that looks like and behave like a real person.

Signing Avatar

Signing Avatar

Signing Avatar

Signing Avatar



Machine translation from Text to Sign Language

- We are exploring:
  - the use of glossing to represent sign language in written form;
  - deep learning for translation;
  - the use of realistic signing avatars to present the translation results.

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Thank you for your attention.

Feel free to contact me: martino@unicamp.br

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Panellist Position

Intelligibility for Adaptive User Interfaces

Alexander Kröner, Nuremberg Institute of Technology, Germany
alexander.kroener@th-nuernberg.de

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GEORG SIMON OHM

Alexander Kröner

TECHNISCHE HOCHSCHULE NÜRNBERG
GEORG SIMON OHM

- Research interests
  - Human-computer interaction, context-aware systems, content-management
- Curriculum vitae
  - Since 2013: Professor for media informatics at Nuremberg Tech
  - 2000-2013 Researcher at the German Research Center for Artificial Intelligence, Intelligent User Interface department
  - 2000 Doctoral thesis “Adaptive Layout of Dynamic Web Pages”, Saarland University
- Selected publications
  - Hönig, V. & Kröner, A. (2021). **Intelligibility of Responsive Webpages: User Perspective**. In: Proc. of The 14th International Conference on Advances in Human-oriented and Personalized Mechanisms, Technologies, and Services (CENTRIC 2021). To appear. IARIA.
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alexander.kroener@th-nuernberg.de

Position Statement

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User interface adaptation may leverage or hamper usability

Example: Approaching the display triggers additional content, which affects layout and font size

- Pro: Additional details enrich content
- Contra: The reader may lose orientation

→ How to solve such a conflict?

User interfaces should take into account the impact of adaption on intelligibility
→Methods for assessing situated intelligibility of a user interface are needed
→Adaptive user interfaces require strategies for preserving and improving intelligibility
→ Such knowledge has to be made available for system developers as well as for autonomous systems

Background: Adaptive User Interfaces

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- Why adaptive user interfaces
  - Tailor human-machine interaction to the user's context (Dey, 2001), e.g., parameters such as location, time, device, (user) capabilities
  - May support usability-related goals such as efficiency and effectiveness (cf. DIN EN ISO 9241-110)
- Selected intelligibility-related issues of adaptive user interfaces
  - Hiding components is common to adapt a user interface to small display sizes; however, this may negatively affect perceived task difficulty (Pernice & Budiu, 2016)
  - Automated adaptation may result in unexpected behavior of a user interface, and eventually to "automation surprise" on behalf of the user (Sarter et al., 1997)
  - Systems acting on behalf of the user may change the mode of a user interface in a way not consistent to the mode expected by the user as discussed by Lee & Eom (2015) for automotive user interfaces

Intelligibility of Adaptive User Interfaces
Issues and Related Research

- User studies addressing adaptive user interfaces
  - Investigate usability issues and express recommendations concerning adaptation for specific contexts such as application and time, e.g., "tourism websites" (Groth & Haslwanter, 2015) or "conference site" (Bernacki et al., 2016)
    - The outcome of merging results from such studies depends on the similarity of these contexts
    - Interaction habits change, e.g., due to the adoption of new technologies, which may require a continuous re-assessment of results
  - Approaches such as contextual participatory design seek to cope with these challenges (Mullins, 2015)
- Approaches strengthening intelligibility
  - Depend on user interface technology and application context
    - E.g., explaining before, during, after interaction using various modalities (for a classification attempt, see Vermeulen, 2014)

Intelligibility of Adaptive User Interfaces
Issues and Related Research

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- Standardization efforts
  - Diversity of contexts may require a diversity of adaptation approaches – and eventually a diversity of approaches strengthening intelligibility
  - Standards express generic recommendations
    - E.g., see recommendations concerning changes in user context mentioned in DIN EN ISO 9241-110
  - For constrained contexts, more precise recommendations can be expressed
    - E.g., see section on adapting to changes in context in Apple (2021)
      - Constrained to a specific software technology stack
      - Focus on mobile / tablet / desktop

Research Questions 1

Assessing Intelligibility

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- Measuring the impact of situational adaptation on intelligibility
  - Intelligibility as a highly diverse parameter
    - Perception of a situation depends on individual user's mental model
    - Intelligibility changes can be difficult to observe (may depend on user interface technology as well as environmental parameters)
  - Goal: Identifying setups suited to observe environmental parameters affecting users' perception of user interface adaptation
    - E.g., identifying simulation approaches that produce results similar to real-world experience
- Modeling expectations concerning adaptive behavior
  - Expectations
    - Users' expectations concerning adaptation are based on experiences with user interfaces
    - User interface technology evolves over time -> expectations concerning adaptation evolve
  - Goal: Change in expectations as part of an intelligibility assessment
    - E.g., an intelligibility model, which takes the evolution of expectations into account

Research Questions 2

Intelligibility improvement strategies

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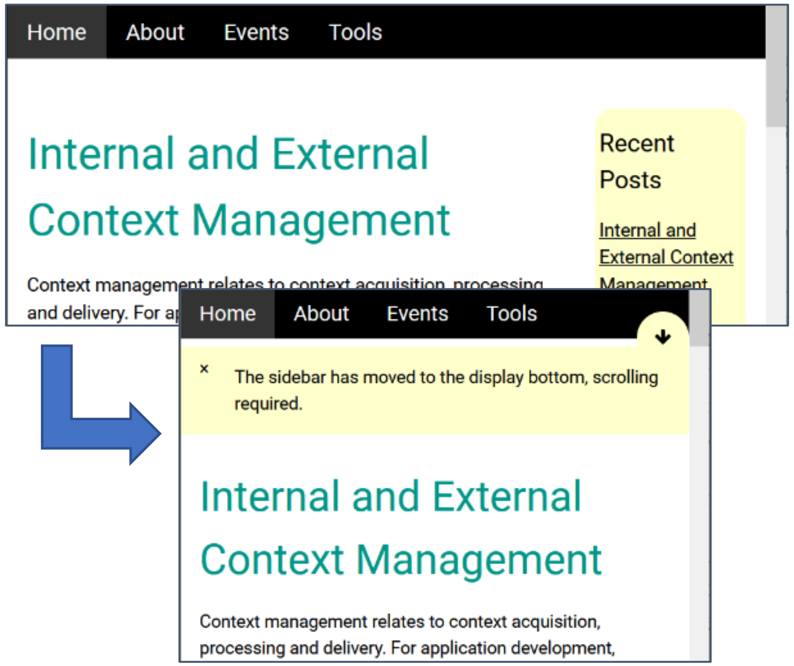
- Identifying strategies for improving intelligibility
  - Diversity of applications suggests intelligibility improvement by design (e.g., based on cognition) as well as explicit modifications of a user interface (e.g., explanation)
    - However, it is unlikely that a single technical solution could fit arbitrary adaptation contexts
  - Goal: Provide assistance in the development of intelligibility-improvement strategies
    - E.g., methods for assessing application (contexts) and matching intelligibility techniques
- Intelligibility-friendly explanation of adaptive behavior
  - Explanations may interact with the overall intelligibility of a user interface in a negative way
    - E.g., explanations may increase the user's cognitive load
  - Goal: Investigate “intelligibility costs” of (explained) adaptation
    - E.g., (contextualized) intelligibility score of adaptive user interfaces



Example: A resize moves a sidebar to the display bottom, where it cannot be seen by the user. This behavior is explained by a textbox – which affects layout and thus may confuse the user.

Research Questions 3

Employing knowledge concerning intelligibility

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- Intelligibility as part of the development process of adaptive user interfaces
  - Developers and designers require knowledge about...
    - Possible adaptations
    - User expectations concerning adaptation
    - Context parameters affecting adaptation
  - Goal: Extending authoring in a way, which supports prediction of changes from adaptive behavior on intelligibility
    - E.g., by simulating users' situated perception of an interface
- Intelligibility-aware automated modification of adaptive behavior
  - Potential negative effect on intelligibility
    - E.g., due to deviations from mental model the user created from previous interactions with a given interface
  - Goal: Integrating intelligibility assessment and intelligibility improvement strategies
    - E.g., based on a learned model of users' individual expectations towards adaptation

Example

Intelligibility of Responsive Webpages (cf. Hönig & Kröner, 2021)

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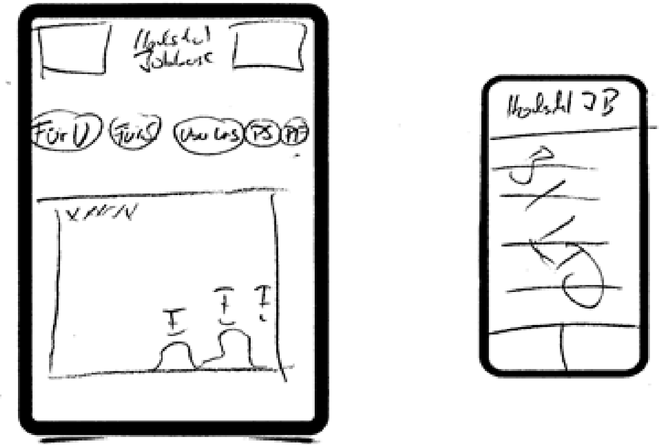
- Goal
  - Make users' (hidden) mental model of adaptation behavior of responsive webpages accessible to developers
  - Relates to research questions "Assessing Intelligibility" and "Employing knowledge concerning intelligibility"
- Approach
  - Online-research concerning current adaptation trends for RWD in selected application areas (shops, newspapers)
  - Conduct a series of experiments (preference tests, first-click test) targeting at various aspects of responsive behavior in order to investigate users' mental model of responsive behavior
  - Interview with developer in order to align conclusions with adaptation decisions made for a specific (real-world) application



Example (preference test): Participants were invited to sketch tablet and mobile layout of a given webpage.

Example

Intelligibility of Responsive Webpages (cf. Hönig & Kröner, 2021)

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- Results
  - Observations concerning users' mental model of selected adaptable aspects of a responsive web page
    - E.g., age group affected adaptation preferences
    - E.g., even minor layout changes may show considerable effect on time to interaction
  - A set of recommendations for RWD-developers, compiled to a guideline
    - Includes references to the underlying experiment in order to provide insights into the context of recommendations
- Limitations (selection)
  - Interaction with participants during experiments constrained by the Corona pandemic
  - Results might partially be biased by content from example application
  - Developer feedback might be biased due to a small number of participants
  - Conclusions concerning users' mental model limited to an isolated point of time (see research question "Assessing Intelligibility")

Summary

Position “Intelligibility for Adaptive User Interfaces”

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- Adaptive user interfaces
  - Highly desired (and required) for user support in a broad variety of usage contexts
  - Adapting a user interface may interact (positively and negatively) with intelligibility
  - Intelligibility depends on (individual and changing) user expectations
- Future research required concerning…
  - Assessing intelligibility
  - Intelligibility improvement strategies
  - Employing knowledge concerning intelligibility
- Contact
  - Alexander Kröner, Nuremberg Institute of Technology, Germany
    alexander.kroener@th-nuernberg.de

Literature

TECHNISCHE HOCHSCHULE NÜRNBERG
GEORG SIMON OHM

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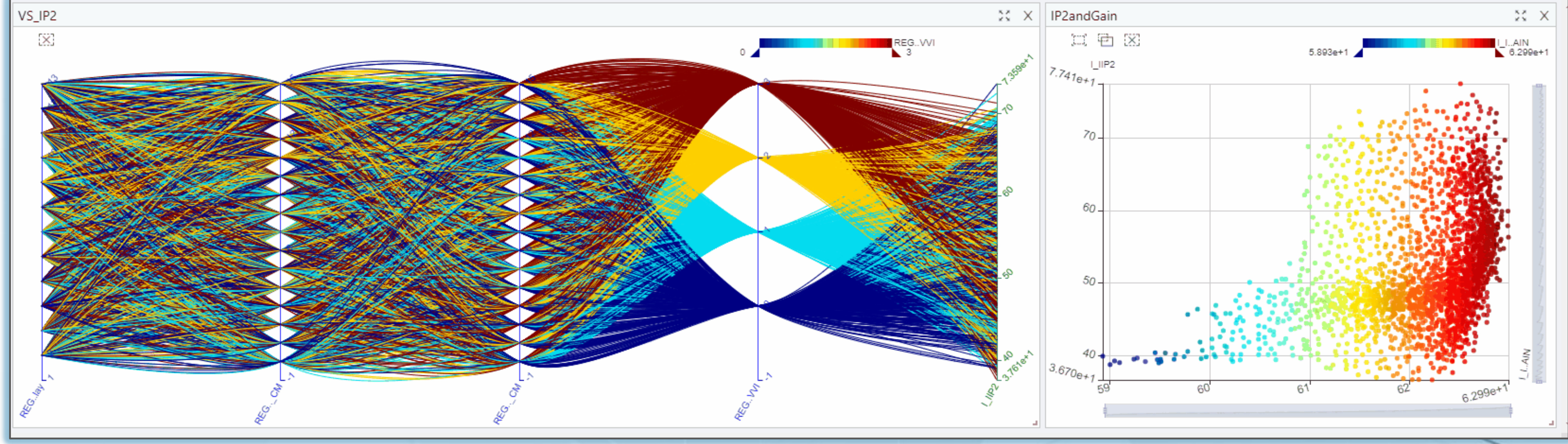

Today’s complexity in validation requires automation by a machine-learning based tool

Lisa Taubensee – Application Engineer,
Jochen Rivoir – Fellow

IARIA

Lisa Taubensee

- M.A.Sc. University of Waterloo – Canada (2005)
- Characterization Engineer/AE Gennum Corp. (2001-2006)
- Application Engineer (AE) Texas Instruments (2007-2014)
- Application Engineer (AE) Synopsys (2014-2019)
- Application Engineer (AE) Advantest (2020 – present)

- Currently supporting post silicon validation solutions
- Interested in new validation methodologies
- Interested in the whole validation chain

lisa.taubensee@advantest.com

Complexity Demands New Post Silicon Validation Methodology

Complexities: Design performance & modes, process, IP blocks, global teams

PSV must ensure that (physical) chip & FW meet all specifications after tuning under all operating conditions & modes with sufficient yield.

Today's PSV relies on expert knowledge / assumptions. Shmoos scan expected dependencies.

Challenges

- Process variations, design complexity and black-box IP blocks lead to unexpected, hard to debug problems under peculiar conditions
- Schedule pressure
- Increasing quality expectations
- Complex collaboration between global teams
- Tuning becomes too complex
- Few experts

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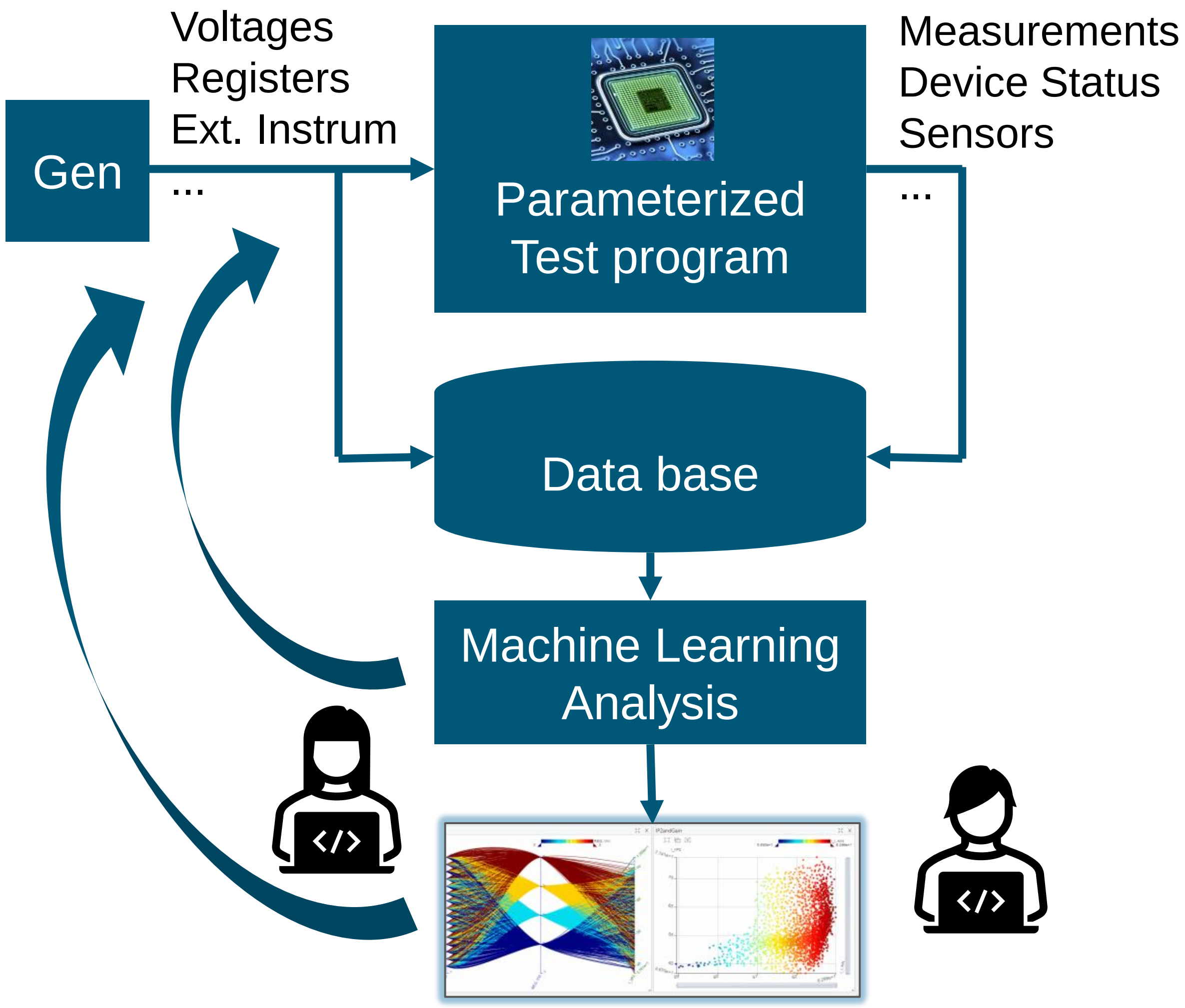
New PSV Methodology



Parameterized test program

- Vary everything, measure everything
- Validates chip + FW + test program

Quality through black-box coverage

- No assumptions → Constrained random tests
- Coverage metrics

Self-learning device exploration loop

Relate inputs to outputs

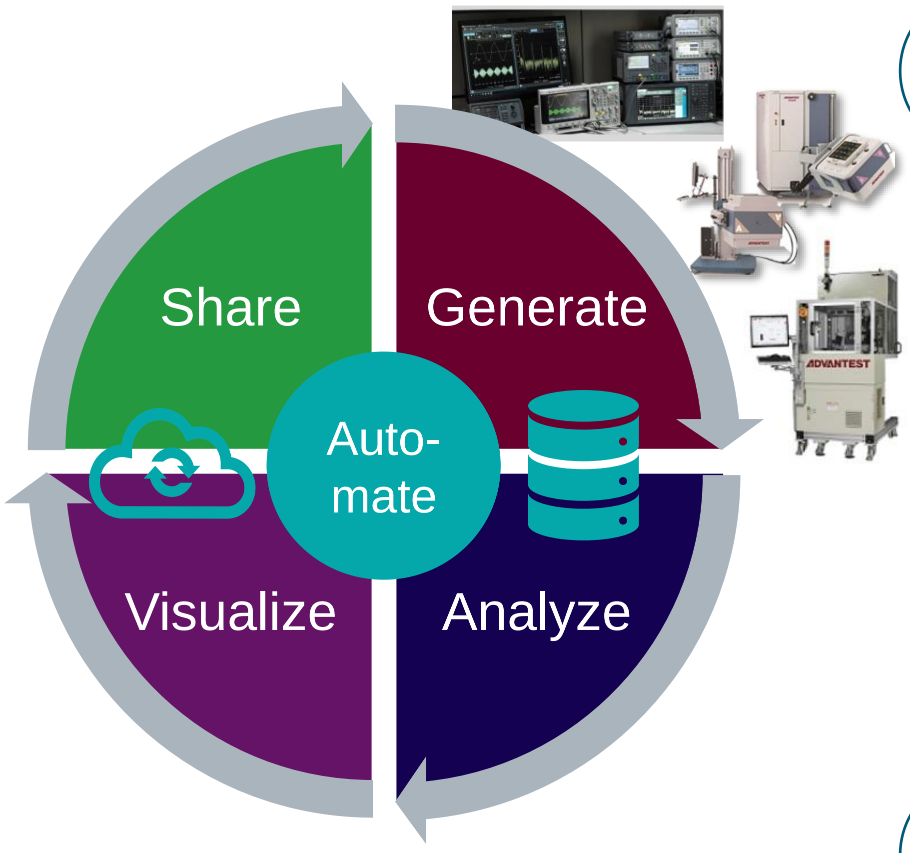
- Create model
- Identify important influences
- Debugging & tuning tools

Interactive post-processing analysis

- Based on comprehensive data
- Generate more data from within plots

Generate

Parameterize and execute test cases automatically for comprehensive coverage



- Highly parameterized test program – no assumptions
- High quantifiable coverage through automatic generation of constrained random tests
- Automate connection to test equipment
- Self-Exploration collects relevant data faster
- Linked inputs and output enable modeling of behavior

Random Coverage is Much Higher Than Shmoo Coverage

Scenario: 25 inputs, want to cover all 10% value intervals, 10k test cases.

There are 300 pairs of 25 variables, and 2300 triples.

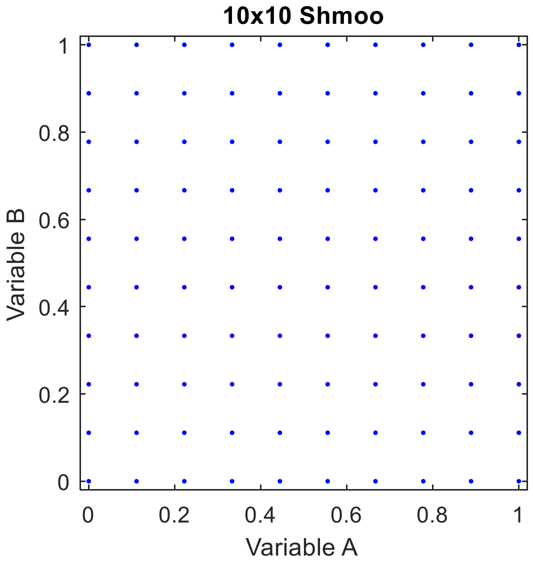
Shmoo: Select 100 suspected most relevant input pairs, run 10x10 Shmoo for each pair.

Pair Coverage: 33 %
(100 % for 100 pairs, 0 % for 200 pairs)

Triple Coverage: 0 %, only pairs were covered.

Shmoos show 100 slices of reality.

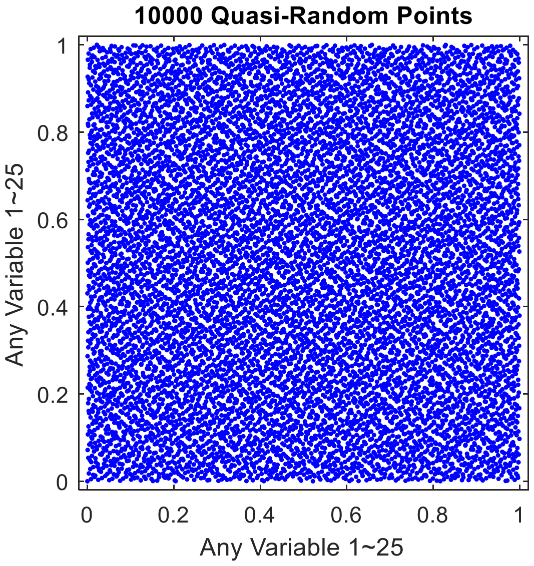
Shmoo tests can find only expected problems.



Random Test: Randomize all input variables simultaneously. Make no assumption!

Pair Coverage: 100 % across all 300 pairs
- Still 100 % with 1k test cases

Triple Coverage: 100 % across all 2300 triples
99.5 % with 3k test cases



Random tests reveal the whole truth.

Random tests find also unexpected problems.

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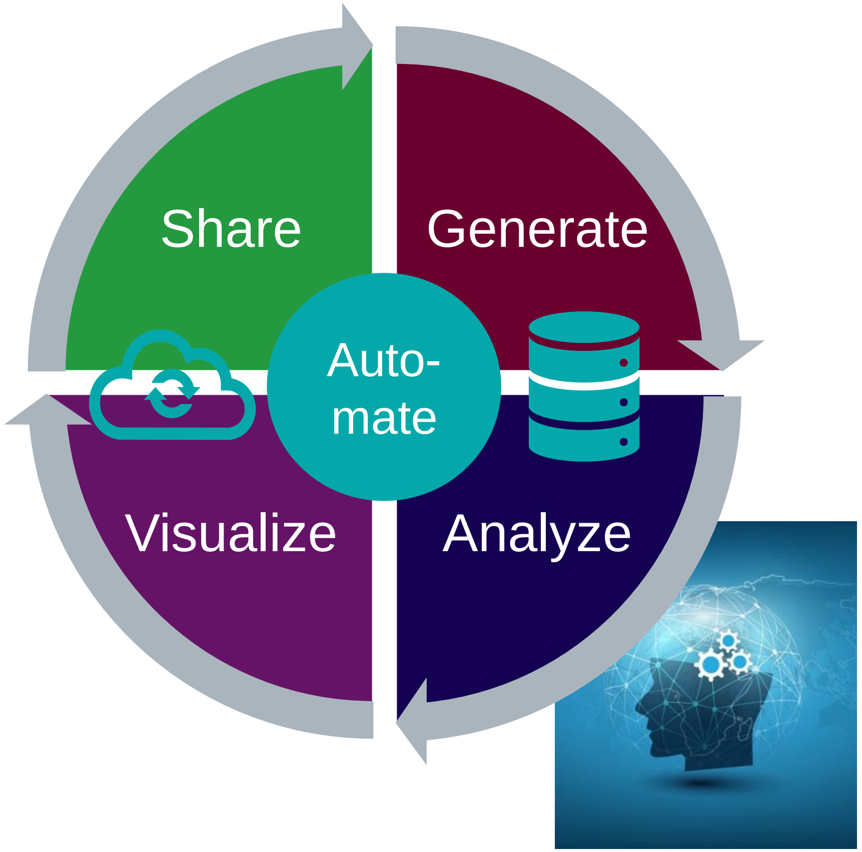
Analyze

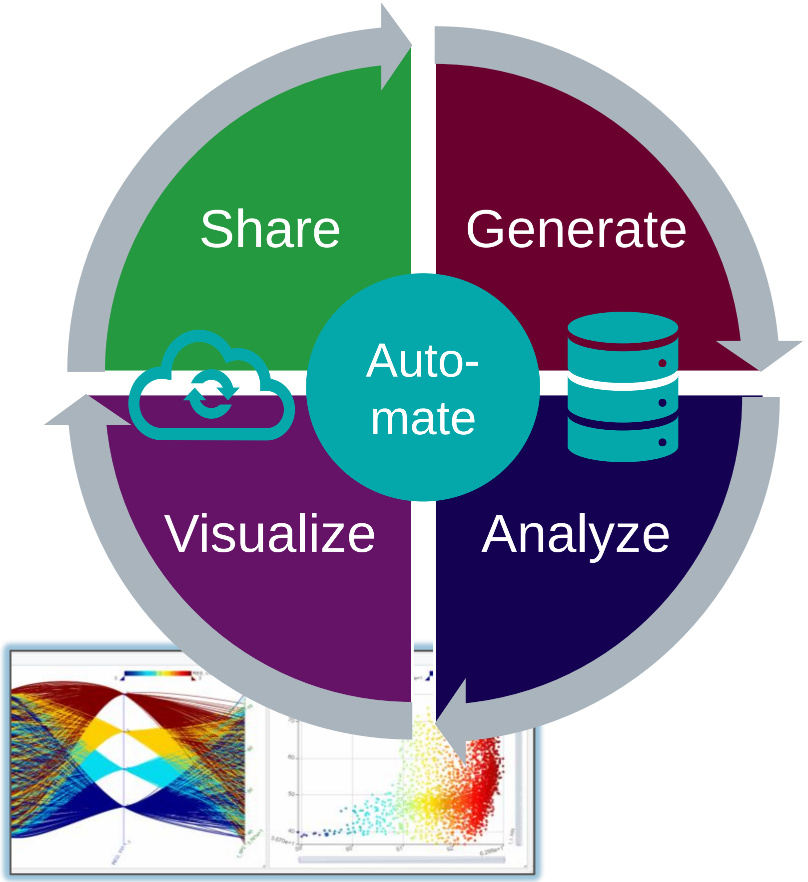
Analyze data immediately as off-line experiments, powered by PSV-specific AI



- Immediate off-line analyses of all gathered data
- Variable selection finds most important dependencies
- Peel-the-onion tool reveals subtle effects
- Split multiple problems for easier debugging
- Model-based what-if analysis
- Automatic AI-based tuning

Visualize

PSV-specific visual analytics for fast insight



- Interactive, linked plots highlight selected data in all plots
- Variable selection picks most informative plots
- Automatic plot type selection
- Highlight statistically significant (small) deviations
- Linked plots of spectra & waveforms
- Interactively run tests from within plots

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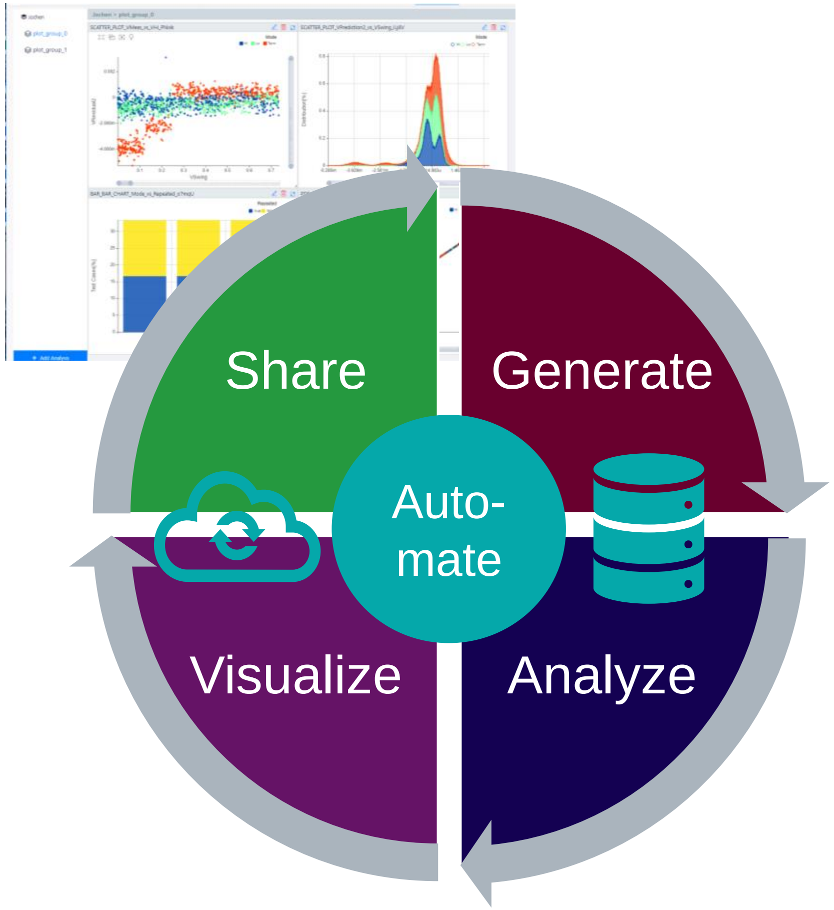
Share

More efficient, unambiguous communication across the globe, 24/7



- Shared access to data and visualizations
- Unambiguous data-driven communication
- Dashboards to monitor PSV progress
- Reports for external partners and archive

Conclusion

The current PSV methodology does not hold for modern complex designs

Traditional methods do not find unexpected problems and are shown to be inefficient

We have come up with a new methodology and tools which deal with these challenges

CHALLENGES IN THE DEVELOPMENT OF CHATBOTS FOR CITIZEN SERVICES

Hochschule RheinMain

Panel Discussion SoftNet 2021
Challenges on Development/Simulation/ Validation for Citizen-centric Systems

Prof. Dr. Stephan Böhm
October 3-7, 2021

INTRODUCTION

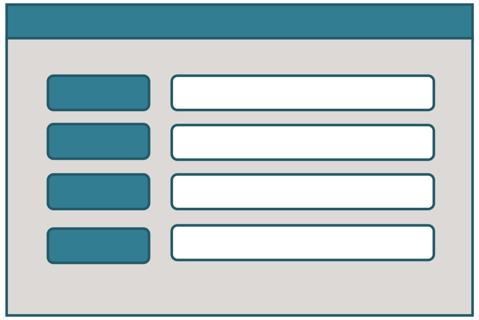
Chatbots as a New Type of User Interface

- Chatbots are computer-based dialog systems and a form of conversational user interfaces
- They support natural language communication
- User interaction can be performed through text input and by speech
- Advances in AI allow better language understanding and identification/matching of user intents
- Deployment for dialog automation in the field of simple conversations (e.g., interactive FAQs)
- Systems are highly available (24/7) and cost-efficient to operate
- Currently, however, the systems are still in their infancy

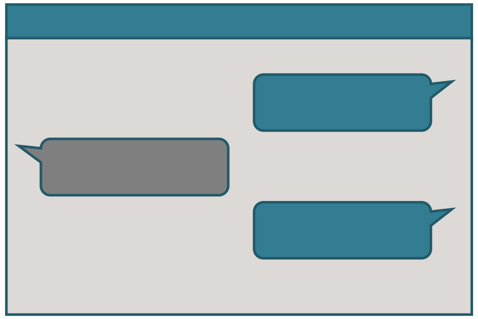
PARADIGM SHIFT

From the User Interface Perspective, Chatbots Mark a Paradigm Shift

- **Classical user interfaces** only accept structured input (e.g., menu item selection, input fields, buttons)
- **Users need to learn** the meaning and operation of user interface elements
- Efficient use of systems requires **adaptation of users to the systems**
- HCI is often based on **search inputs and result lists**



- **Conversational interfaces** try to understand the natural language of users
- **Systems must learn** to understand user needs and individual user input
- Efficient usage requires **adaptive and learning capabilities of systems**
- HCI turns into a **dialog of questions and answers**

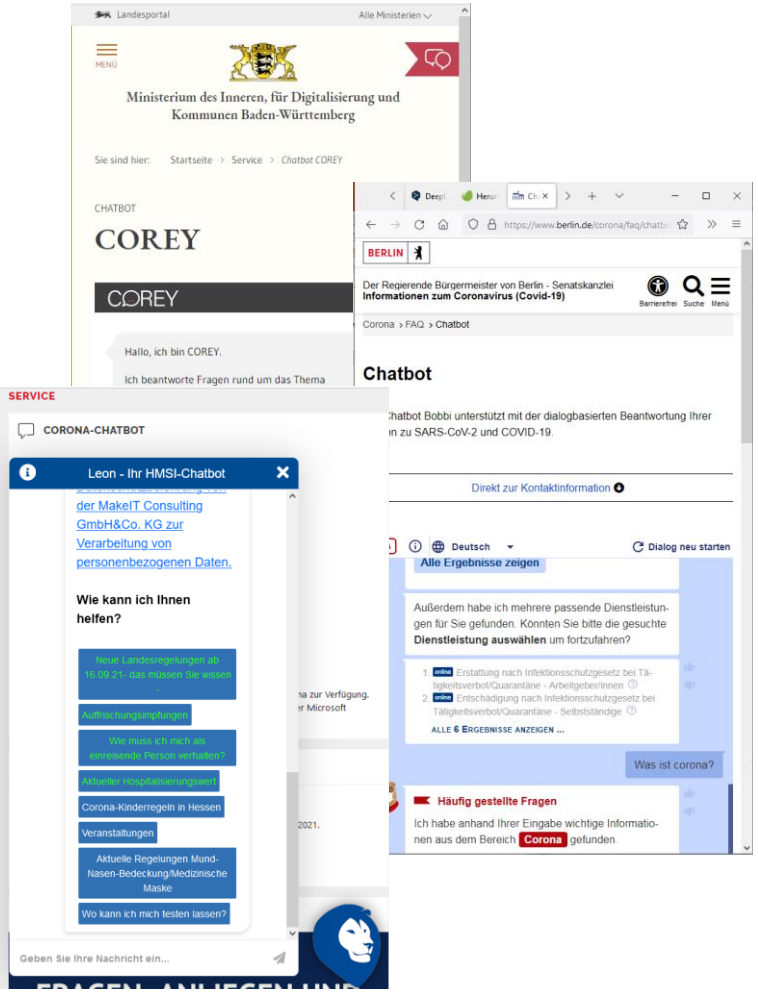


Sources: X

CHATBOTS IN CITIZEN SERVICES

Challenges and Perspectives

- Potential for citizen services especially where many standard requests have to be answered
- Chatbots offer access to information even outside business hours of authorities (24/7)
- More comprehensive matters and information requests can be captured in structured dialogs
- It is important for the acceptance of such systems that the chatbot can be identified as computer system
- Chatbots are most effective for simple standard queries and as a "first level support"
- More complex queries should be handed over to human agents as “second level support”
- Chatbots can be used to cope with high information demands in situations like the Covid-19 pandemic



Sources: Examples of German Covid-19 chatbots,
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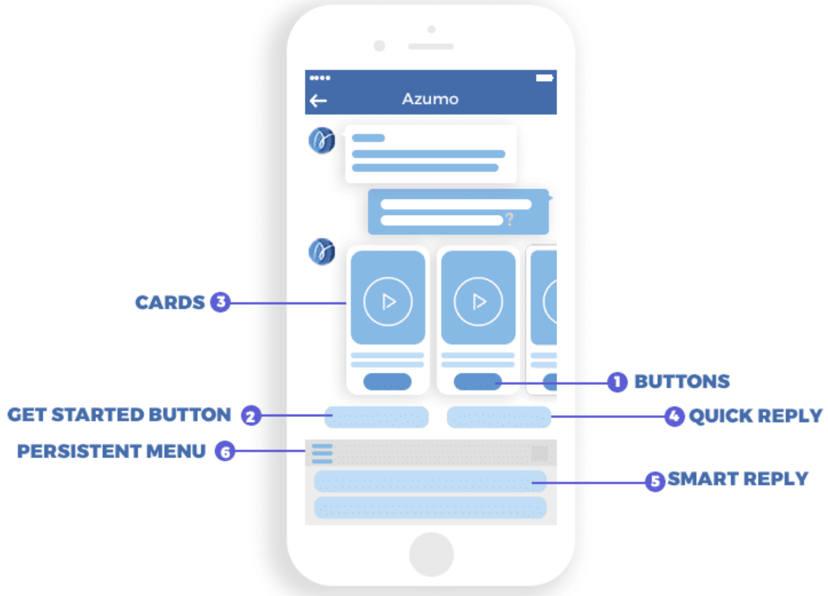
CONVERSATIONAL DESIGN

Chatbot Development from the User Design Perspective

- Conversational design describes the process of designing user interfaces for dialog-based computer systems
- In the context of conversational design, the user interface of a chatbot is designed, the dialog flow is modeled, and dialog elements to be integrated are selected
- In contrast to user interface design for graphical user interfaces, the focus is on textual or natural language communication between humans and computer systems
- In addition, elements such as the personality and tonality of the chatbot can be further design objects

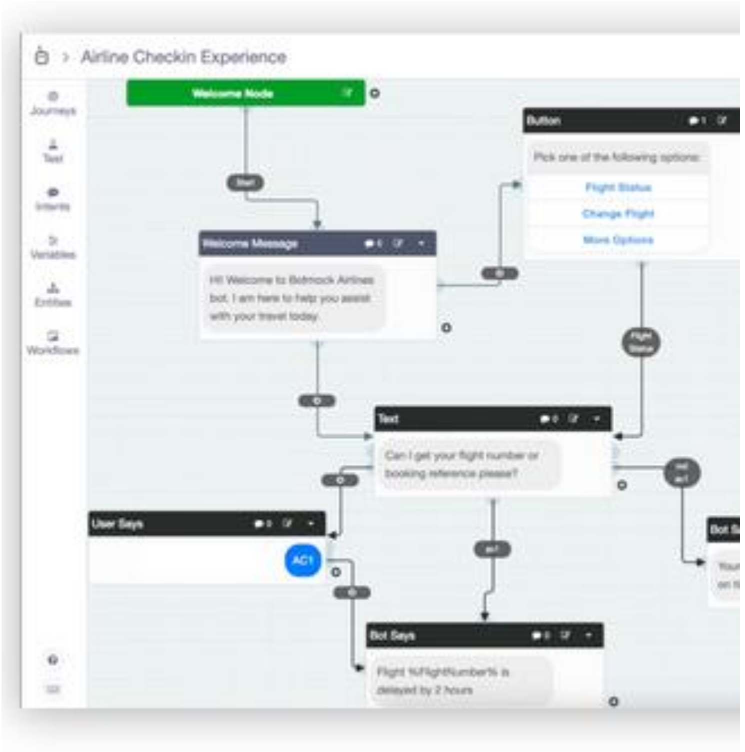


Picture Source: https://azumo.co/chatbot-design-elements

CONVERSATIONAL DESIGN BASICS

Basic Steps of Chatbot Development

- Define the scope of the chatbot and identify possible user intentions (intents) for a conversation with the chatbot
- Identify contexts and parameters (entities) that can modify user intentions (e.g., location)
- Use analyzed contexts to model dialog flows and connect system actions as well as external data sources for system responses
- Initially train chatbot system with a set of pre-classified sample questions for the identified user intents, test and improve the system through editorial maintenance

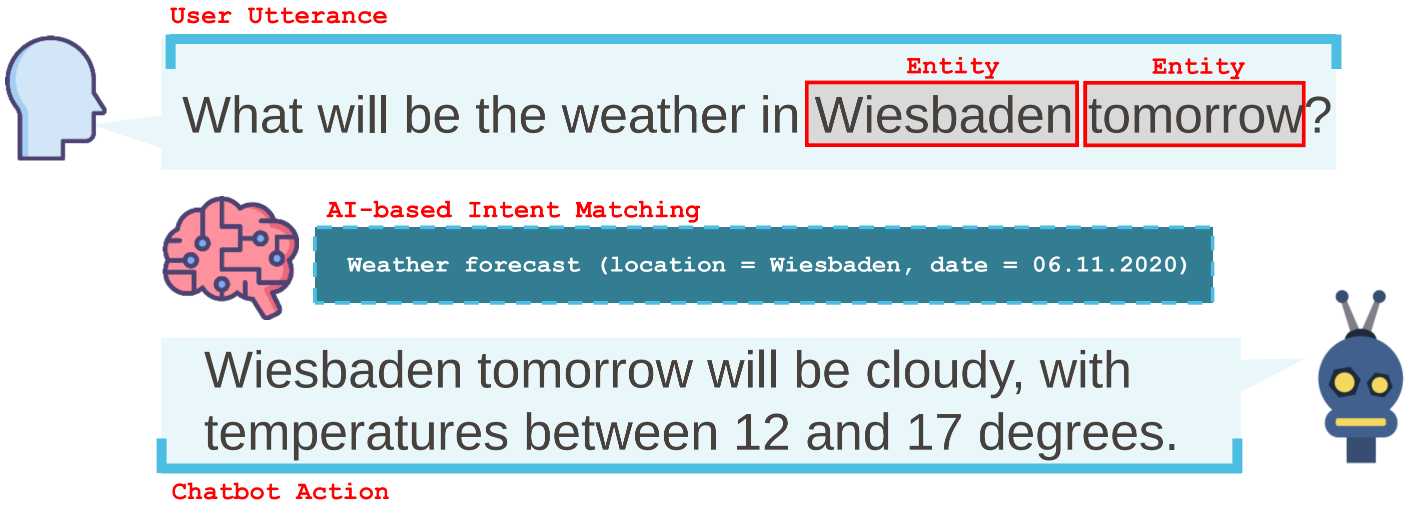


Picture Source: https://botmock.com/features/collaboration/

BASIC ELEMENTS OF CONVERSATIONAL DESIGN

User Utterances, User Intents, Entities and System Actions

- The challenge is that chatbots must associate many user inputs with a clear user intent
- The intentions can be formulated differently in terms of language or vary slightly in their external references
- Modern AI can help here, but chatbot performance also strongly depends on the quality of dialog modeling



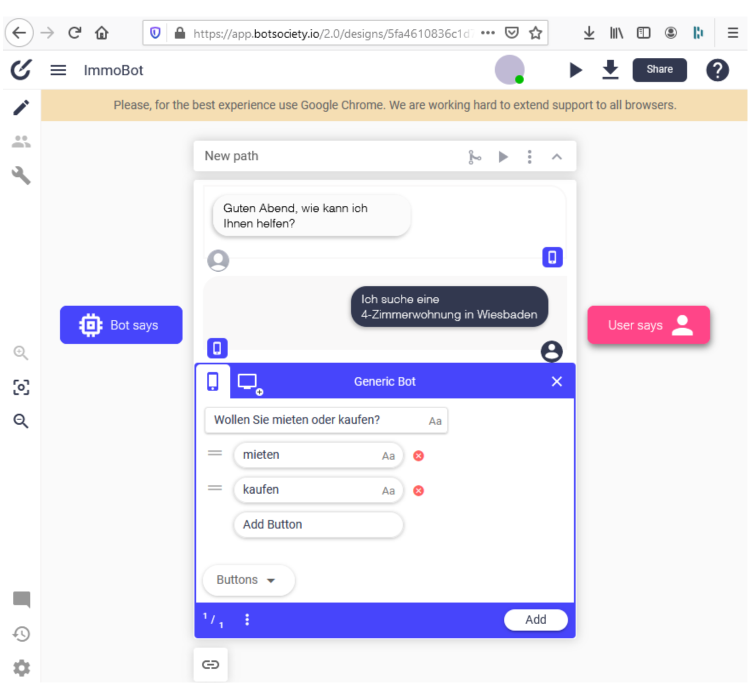
CHATBOT PROTOTYPING

Simulating the Chatbot User Experience

- For initial tests with users, conversational flows can be transferred into interactive prototypes or videos demonstrators to present the intended course of the dialog

- However, the presentation is similar to a "click dummy" (e.g., in app prototyping), so it is more about the structure than the later "quality" of the conversation.

Prototyping Environment (Botmock)



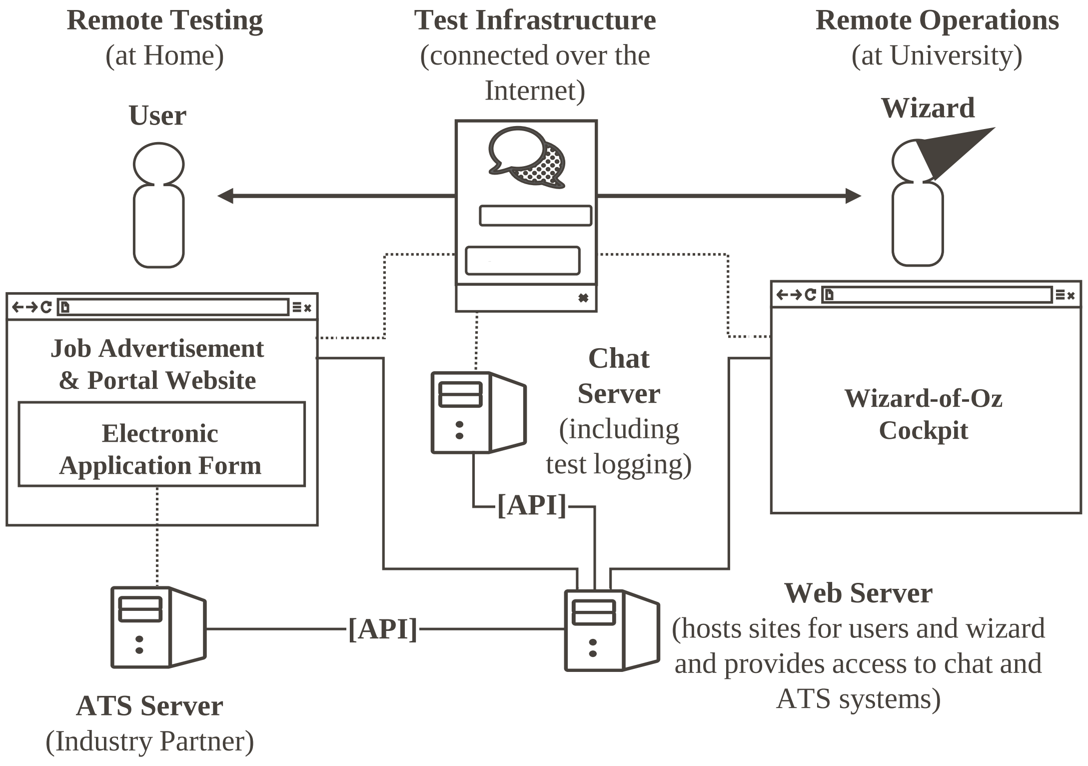
Viewer

Source: https://app.botsociety.io

SIMULATING CHATBOTS IN EARLY PHASES

Wizard-of-Oz-Testing

- WOz testing is an alternative or supplement to chatbot prototyping in early phases
- A human operator (wizard) simulates the chatbot (so no chatbot coding required)
- Fast realization and extensive interaction for user analysis can be realized
- Important is an authentic simulation by limiting the system response to the capabilities of the planned system
- WOz testing can be also bei used to collect and complement initial intent sets



Source: HSRM Research Project

SUMMARY

Conclusions and Outlook

- Chatbots represent a new, innovative channel for citizen services and offer automation potential for standard situations – but the technology is still in its infancy
- The emergence of chatbots indicates a paradigm shift for interactive user interfaces – machines must learn to understand users and no longer the other way around
- The realization of chatbots offers many new challenges and differs significantly from conventional "User Interface Design" for "Graphical User Interfaces“
- Prototyping and simulation of chatbot concepts in early phases can help to gather important insights for a user-oriented design
- The marketing promise that chatbots can easily build by “click & drop" is misleading – this often results in "trials" without any value which quickly disappear from the market

LITERATURE

Additional Recommended Literature on the Author’s Position

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- Böhm, S./Drebert, J./Meurer, S. (2020). Wizard-of-Oz Testing as an Instrument for Chatbot Development. An experimental Pre-study for Setting up a Recruiting Chatbot Prototype . In *The Thirteenth International Conference on Advances in Human oriented and Personalized Mechanisms, Technologies, and Services, CENTRIC 2020*. 48-56, https://www.thinkmind.org/index.php?view=article&articleid=centric_2020_1_90_30036.
- Meurer, S./ Drebert, J./Böhm, S./Linnyk, O./Kohl, J./Locke, H./Teetz, I./Novakovskij, L. (2020). „Intent identification and analysis for user-centered chatbot design: A case study on the example of recruiting chatbots in Germany“. In *The Thirteenth International Conference on Advances in Human oriented and Personalized Mechanisms, Technologies, and Services, CENTRIC 2020*, 34-43, https://www.thinkmind.org/index.php?view=article&articleid=centric_2020_1_70_30030.