Conferences, Coffee and Complexity
Supporting Cognition and Communication at Conventions

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Abstract — This article takes information visualization to the field of academic conferences and conventions, to explore how cognition and communication of participants could be supported in such ephemeral, knowledge-intensive environments. With focus on a non-invasive method of data collection, we consider the levels of topical, social, temporal and spatial orientation as primary working areas for any support system. Across these areas, overviews and personalized detail-views have to be intertwined, to allow for the localization and navigation of individual participants. To demonstrate a lean approach to these challenges, we introduce a visual conference exploration system, that allows participants to visually explore conferences before, during and after their attendance and support their personal knowledge management by making use of recommendations, which help to establish new contacts, or find the most interesting panels and talks.

Keywords - information visualization; conferences; cognition support; communication support; personal knowledge management

I. INTRODUCTION

Academic conferences are uniquely condensed constellations of actors and their expertise in space and time. As such, they allow for the intensified exchange between usually disconnected knowledge carriers, promising to update and support their cognition on relevant subject areas within their co-located communities of knowledge and practice. As an unintended result, conferences are commonly posing significant challenges to the cognition of their participants with regard to questions of how to optimally navigate these immersive spaces of epistemic, social, temporal, and spatial complexity. Exemplarily, initial questions regularly rotate around overview tasks like “What are this year’s subject areas?”, “Who is here?”, “What’s on the schedule?”, “Does it attract my interests?” and “How do I get there?”. Building on these basic questions are sequential and combinatorial challenges of how to select and navigate different panels and talks during a day and how to find and combine interesting people to socially interact with during the informal stretches in between a tightly packed schedule. As the exemplary type of intermission, it is most commonly the coffee break during which simultaneously complexity has to be reduced, orientation to be ensured, recent topics to be discussed, existing contacts to be updated, and new contacts to be established.

With information visualization promising to amplify cognitive performance and to speed our understanding and action in a world of increasing information volumes [1], conferences and conventions seem to be an obvious area of application. Yet it has been only recently, that research teams started to develop visual analytical methods and applications to tackle some of the accompanying challenges – and to reflect on this specific working area in the context of conferences. In the following sections, we will discuss this current work (sec.2), reframe some common data, task and design challenges (sec.3), and introduce a conference visualization system, which has been prototypically developed to meet a diversity of exploration and navigation challenges from a synoptic participant perspective (sec. 4). First evaluation results (sec. 5) will be complemented by outlooks on noteworthy development challenges and future work.

II. RELATED WORK

On a general level, the topic of conference and convention management is an extensive subject area, comprising a broad range of subtopics [2] and disposing of a multitude of tools. These are predominantly supporting conference organizers in the run-up to an event with complex paper submission and review processes, copyright management, the scheduling of talks, and the administration of participants [3] [4].

Associated to this organizer-oriented development field is research into information and communication technologies, to offer cognition and communication support to individual participants. In general such technologies could be categorized in many ways. Klein [5] provides a valuable overview on early community and matchmaking support systems, and distinguishes three different categories by looking on the possible types of end user devices. Whichever information in detail, support can reach conference participants via a) big screens on walls, b) by their name tags, via c) mobile devices and (web) applications – or any combination thereof [6].

A) Public screens on the walls of conference facilities can serve as so called “community mirrors” [7] [8]. One of their interesting effects – aside delivering an image of the conference or participant groups otherwise unseen – is their communication fostering character, as multiple persons can interact with the information on screen, thus sharing their insights, opinions, further news, etc.
B) Name tag systems utilize the little badges for information transfer, which everyone is used to carry around on conferences either way. Upgraded with capacity for location-awareness, mostly achieved by active RFID sensors, these badges exemplarily provide information by light emitting diodes or small displays [9]. To support communication, name tags can store information about their users and with adding sensor capacity for the proximity of other tags, badges can react to each other, to display how much two users are matching each other’s favored subject areas or propensities [10].

C) Systems based on handhelds or web applications are delivering relevant information and visualizations to the screens of personal assistants or mobile devices - but can also be used via personal computers or projected to public screens. A possible differentiation of these systems comes from their focus on specific information or support functions. Systems with focus on temporal information and orientation can offer to enhance the personal schedule planning process for conferences, support the selection process by recommendation of talks, support the temporal navigation with real-time data and alarms, and support the documentation through storing all the sequences and personal annotations [11]. Concerning the recommendation of talks, different approaches and algorithms have been discussed: matching by meta-data of talks and persons, matching by preferences of social communities, matching by individual preferences and contents, as well as different combinations thereof [12].

Systems with emphasis on social information and orientation elaborate on functions of interpersonal matchmaking and recommendations – and commonly integrate real-time data from wearable sensors (i.e. mostly based on location and interaction aware RFID badges) into their data collection. With such sensor platforms, the interactions and dynamics of person-to-person networks can be investigated with increasing spatial and temporal fidelity, which allows to visualize the evolution of social patterns as community mirrors in real-time [13]. Building on further knowledge about conference participants (e.g. by drawing associated subject areas or co-authors from publication databases), such systems can derive connections and similarities of any two actors [14], store the history of new contacts and their profiles for documentation purposes [15], or help to locate and find new contacts in real space [16]. With including user data generated in real-time (e.g. of interpersonal meetings or visited sessions), matchmaking algorithms could be further refined and resulting recommendations fed back to the participants [17]. With using such sensor platforms for extended data collection and subsequent evaluation on the basis of network analytical or statistical procedures, investigations into the structural and temporal anatomies of conferences become possible [18].

This overview on recent works shows a growing interest in the development of new ICT tools and methods for conference analysis and visualization – combined with the practical aim to amplify the real-world cognition and communication of academic gatherings and communities. While a lot of work is exploring the theoretical options offered by real-time data collection of new sensor technologies like RFID, we think that a few points specifically deserve some further consideration, when it comes to InfoVis systems designed for real-world use and application. The following chapter elaborates on some of the most relevant challenges, which we encountered during a research project 1, and which have been answered by the prototypical development of an integrated conference visualization system to be introduced further down.

III. DATA, TASKS AND DESIGN DECISIONS

Given the advanced options of data collection and analysis mentioned above, initial considerations focused on questions of data collection efforts, methods adequacy and user privacy.

A. Data

With regard to the growing number of methods for data collection – from questionnaires to real-time RFID monitoring – a number of crucial factors have to be balanced to ensure acceptable efforts and proceedings on the organizers’, as well as on the participants’ side. When it comes to practical applicability, each data collection method requires specific efforts (time of use and costs of devices) on implementation and operation. Aside that, collected data has to meet all the requirements defined by intended analytical tasks (see 3.2) and their corresponding visualizations (3.3). But not least, questions of a method’s invasiveness, related privacy and data protection issues play a crucial role when planning an information system for general use.

Decisions: Concerning the required trade-off between (temporal and economic) costs and benefits, we identified simple and standardized online questionnaires as the most promising option to collect a robust and reliable data basis for yet a broad range of visual-analytical tasks with a minimum degree of invasiveness. With a lean and simple list of its subject areas, any conference can request its participants to specify their personal interests during the registration process. After doing so, each attendee still has to authorize intentionally whether these data will be approved for further processing. Complementing to these “interest tags” assigned to all actors, all the sessions, talks, or posters of a conference have to be similarly tagged with their affiliated subject areas. Preconfigured by their keywords, such tags could be further extended or refined by presenters and organizers alike. Given this data, a broad range of valuable overviews – and corresponding personal recommendations – become computable, yet all options for subsequent data enrichment by the means of other mixed method designs are obviously maintained.

B. Tasks

Coming back to the complexity of a conference’s coffee break, we had to determine: What are the main challenges or problem areas conference attendees have to deal with? What are the frequently asked questions, equaling the most

1 www.donau-uni.ac.at/en/ena
relevant tasks that should be supported? Drawing from numerous interviews and conversations with organizers, researchers, stakeholders, and a broad background of personal user experience in the conference realm, we established a non-exhaustive shortlist of frequently recurring tasks and questions:

- **Topical orientation**: What are the subject areas of a conference — and which persons or talks are affiliated to each of these areas?
- **Social orientation**: Who are all the participants of a conference? Whom do I know, and who has which interests or areas of expertise?
- **Temporal orientation**: What is the program of this conference? Which panels are hosting which actors and presentations according to the schedule?
- **Spatial orientation**: Where do I find which room? What does the whole conference space look like? Where do I find sessions, topics and talks?

While we interpreted such basic questions to signify the need for (at least) four correspondingly basic perspectives on any given conference on the **overview** level, we easily derived various requirements for **zooming and filtering** (e.g. Show me all the people of subject area X! Find all the talks related to Y!), as well as **details on demand** (What is this talk about?) by the well-established information seeking mantra of Shneiderman [19]. Though this already allows for in-depth exploration of any conference, we found that the most relevant details for participants mostly coincide with their own profile of personal interests. This led to an extension of system requirements:

- **Personal orientation and recommendation**: All the abovementioned views should enable the highlighting of the personally most relevant information (e.g.: Who is sharing most of my interests? Which talks are matching my research profile best? Which rooms are hosting the most interesting talks in the afternoon?) As such, each view was designed to offer personal orientation and recommendations on demand.
- **Interpersonal communication**: To allow for the initial contact and further conversation between actors of shared interest, a messaging system was found to provide a crucial functionality. With enabling the exchange between all attendees, its main objective is to offer a bridge from a system of virtual recommendations to real-world interaction via the intermediary level of direct messages.
- **Extended temporal use**: We found that any system supporting the abovementioned set of tasks was expected to be of help not only during a conference, but also before a convention (for information and preparation purposes) – as well as thereafter (for documentation reasons and ongoing communication).

**Decisions**: After stabilizing and prioritizing a list of frequently requested tasks and functionalities, we ensured the feasibility of analytical procedures with regard to the intended types of collected data. Treating persons and talks as our main types of nodes, the affiliated subject areas helped us to derive a multimodal affiliation network, which delivered the basis to subsequently compute and visualize only the strongest connections (i.e. between persons, or between persons and talks). Among these strongly connected nodes, a matching algorithm helps to identify and rank the most similar entities – and deliver a final shortlist of personal recommendations. With conference schedules providing further connections between talks and rooms, we could also calculate recommendations for which room to go to – based on the talks it hosted over a certain period of time.

### C. Visual-analytical design

Building on these major tasks, we assessed different information visualization methods to provide the best layout method for the four selected main views.

**Decisions**: While we decided to offer topical orientation with a treemap, and social orientation via a node-link diagram, the tasks of temporal and spatial orientation were assigned to the more conventional solutions of a time table and a floor plan. All of these views should be enriched with interaction methods, complemented by a navigation and information panel, and equipped with a coherently colored highlighting function for personally relevant data as depicted below.

### IV. Virtual Conference Explorer

Building on research into the web usability of different visualization libraries, the prototype was developed as a web application, working with D3.js (d3js.org). This allows users to access the Conference Explorer from every modern web browser, including tablets and smart phones.

![Figure 1. Topical orientation: The treemap shows all the subtopics of a conference, weighted by the participants’ interests](image)

Figure 1 shows the overview for topical orientation. By looking on the weighted treemap layout, participants can quickly perceive larger subtopics of a conference (marked with different colors), and their affiliated single subject areas, delineated by boxes. While a selection of a single area shows affiliated talks and participants on the right, the
weighting of each area (i.e. its size) is driven by data on the amount of affiliated persons. As such, the relative distribution of all participants’ interests is inscribed into the overview. The use of the personal highlighting function accentuates the individual distribution of interests by brighter shades on demand.

Figure 2. Social orientation: The similarity network of participants shows recommended discussion partners for selected actors (green)

Figure 2 shows the network overview, to provide social orientation on all registered participants in form of a zoomable node-link diagram. While the information panel on the right shows details of selected actors (e.g. name and interests), the edges between persons are visualizing the existence of high degrees of computed similarity. As such, this virtual network indicates supposedly interesting contacts for subject-specific conversation. On demand, the highlighting function for personally relevant data accentuates the ego network of the operating user (bright green) with green color. In parallel, these most relevant actors are also enlisted as top recommendations on the right hand side. In case of further interest on the user’s side, an integrated messaging system allows to directly connect to recommended actors – and to realize the virtual edges by factual knowledge exchange via web or in the real-world environment of the conference.

Figure 3: Temporal orientation: The time table shows talks and presentations, with personal recommendations highlighted in green

Figure 3 offers a glance on a conference time table, providing temporal orientation. In this specific case, 3 different panels are visualized as columns, with details on each talk available on the right hand side. These details include title, subtitle, name of presenter, affiliation, time of talk, room, keywords and the associated abstract. On demand, the highlighting function shows with shades of green how far the talks are matching the interests of the operating user. Aside rising the perceptibility of single presentations, a more distant or comparative reading of the colors allows the user to identify the most promising panels to participate.

Figure 4: Spatial orientation: The map shows a conference facility, with recommended rooms highlighted in green

Spatial orientation is finally provided by a floor plan, integrated into a map of the surrounding conference facility (Fig. 4). While the overview map marks conference rooms in relation to the overall architecture and points of interest, the detail view on the right shows all the talks and presentations, assigned to each room. On demand, the personal highlighting function again shows with shades of green, which room is hosting the most interesting talks over a certain amount of time.

The four main views of the Conference Explorer were enriched by a view-specific search function, and complemented by a simple messaging system, which allows to contact all signed participants. After opening the messaging window, incoming messages are displayed as personal threads, while new messages could be initiated with searching for any actor, or choosing the recipient from a register.

V. Evaluation

To test the Conference Explorer in a real-world setup and evaluate the prototype as described above, we implemented a first version as part of a two-day conference with about 200 participants and 40 talks, dedicated to the subject areas of knowledge management and visualization.

The participants’ data was collected with a separate registration process and access to the explorer was granted two weeks before the event. During the convention, participants could access the explorer with their web-accounts, or make use of a public version, screened on an interactive whiteboard in the entrance area. This public interface did not only directly support and foster the communication between users and bystanders, but it also allowed to display the personal recommendations by swiping
a RFID chip, hidden behind the name tags. Furthermore, this setup allowed us to gather feedback of visiting users by conducting semi-structured interviews.

A total of 23 people were surveyed in detail during the conference, with the vast majority declaring to be either satisfied or mainly satisfied with the Conference Explorer. The participants felt that the tool shows a lot of potential, especially with regard to the option to use it already prior to a conference – which yet only half of the responders did. The topical, social and temporal orientation support were the functions used most frequently during the actual conference. A range of suggestions for further improvement was documented in the course of the evaluation. Frequent wishes included a link to other social networking applications, or the use of pictures to make people easier to find. Further log file analyses indicated that the Event Explorer was also used after the conference to review the conference itself, the programme, the speakers and other participants. While this feedback is already informing further software development cycles, we also plan for further testing within the context of upcoming case studies.

VI. CONCLUSIONS AND OUTLOOK

In this article, we took methods of information visualization to the application area of conventions and conferences, to amplify attendees' cognition and communication performance. In spite of numerous sophisticated methods and technologies for collecting and analyzing real-time participant data, we found a simple, lean and non-invasive data collection setup to provide the most promising basis for wide-spread practical use. Building on a collection of frequently requested tasks, we designed a system for visual conference exploration and recommendation, and tested a prototype in the context of a mid-size conference. Building on our experiences and evaluation results so far, we can delineate the main challenges, to be tackled by future work:

- With following an integrated approach, we think of multi-perspective solutions (i.e. combination of different views, supply of overview and detail, general and personal access) as the most balanced and robust strategy for providing orientation across different users and their specific tasks. As such, further development has to aim for constant optimization of single functionalities (e.g. layouts, matching algorithms, messaging options), yet to keep system performance and user experience fluid.
- With different types of conferences and different types of user groups comes a diversification of requirements for cognition and communication support. Against this background, we consider it as necessary to develop specific awareness for different user and event types (e.g. by compiling a taxonomy), and to meet their different needs with extended or adapted visualization modules. This should allow to better customize conference visualization systems for all areas of application.
- While we consider a lean and non-invasive approach to data collection as a sort of precondition for general application in the rather sensitive academic realm, the extension of data collection and processing methods (e.g. complementary data mining, location-aware sensors, social badges, user generated content) remains of high interest for specific setups and user groups. Also organizers' interests in optimization of conference administration and evaluation would strongly benefit from such developments. Yet to ensure a broad acceptance, we consider a distinct sensitivity towards privacy issues as a necessary precursor of any development.
- Finally, as a crucial practical challenge, the development of functions to bridge from virtual to real space is ranging high. In parallel to the refinement of matching algorithms, ICT systems for conferences must not lose sight of ideal solutions for the real-time communication support in complex and crowded environments. As such, the close connection to emerging mobile technologies seems indispensable.

As long as future developments remain considerate of the readiness or reservation of real users, this will allow them to free their cognition and communication from weary navigation exercises and to refocus on the more interesting stuff.

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