



NEWSLETTER 2014

News and events

Risk-Limiting Audit of the EU Election

How can we determine whether vote-counting systems, manual or technology based, have performed well in specific elections? A risk-limiting post-election audit can ensure that elections are accurate. A risk-limiting audit confirms statistically that the correct electoral outcome is correct.

"Electoral outcome" means, for instance, the number of seats each party gets, the candidates who receive seats, or whether a referendum won or lost. Risk-limiting audits involve manually inspecting randomly selected ballots. The audit examines more ballots until the inspection has given strong evidence that the outcome is correct, or--if that does not happen--until there has been a full manual count to check the outcome.

Risk-limiting audits are designed to minimize the number of ballots that must be inspected when the outcome is correct, while ensuring a large, pre-specified chance of correcting the outcome if the outcome is wrong. For example, if the original outcome is incorrect, a risk-limiting audit with a risk limit of 10% has a 90% chance of correcting the outcome. It will never alter outcomes that are already correct.

Denmark was trying Risk-Limiting post-election audits for the first time in May 2014, to check its portion of the European

Parliamentary Election. We inspected circa 150 ballots from the nation as a whole. Each municipality's share of the work is roughly in proportion to the number of ballots cast in that municipality.

In the "fine count," municipalities sort, count, and bundle the voted ballots. Each bundle is supposed to contain ballots with the same votes, for instance, all ballots in a bundle should show a vote for the same candidate. The election can be audited efficiently if each municipality provides the auditors a list of all its bundles of ballots, together with the number of ballots in each bundle and the name of the candidate, party, or position that the ballots in that bundle are supposed to show.

This pilot was supported by the Ministry of the Interior and Economic Affairs, and in collaboration with Local Government Denmark (in Danish: KL).

Voter Lines

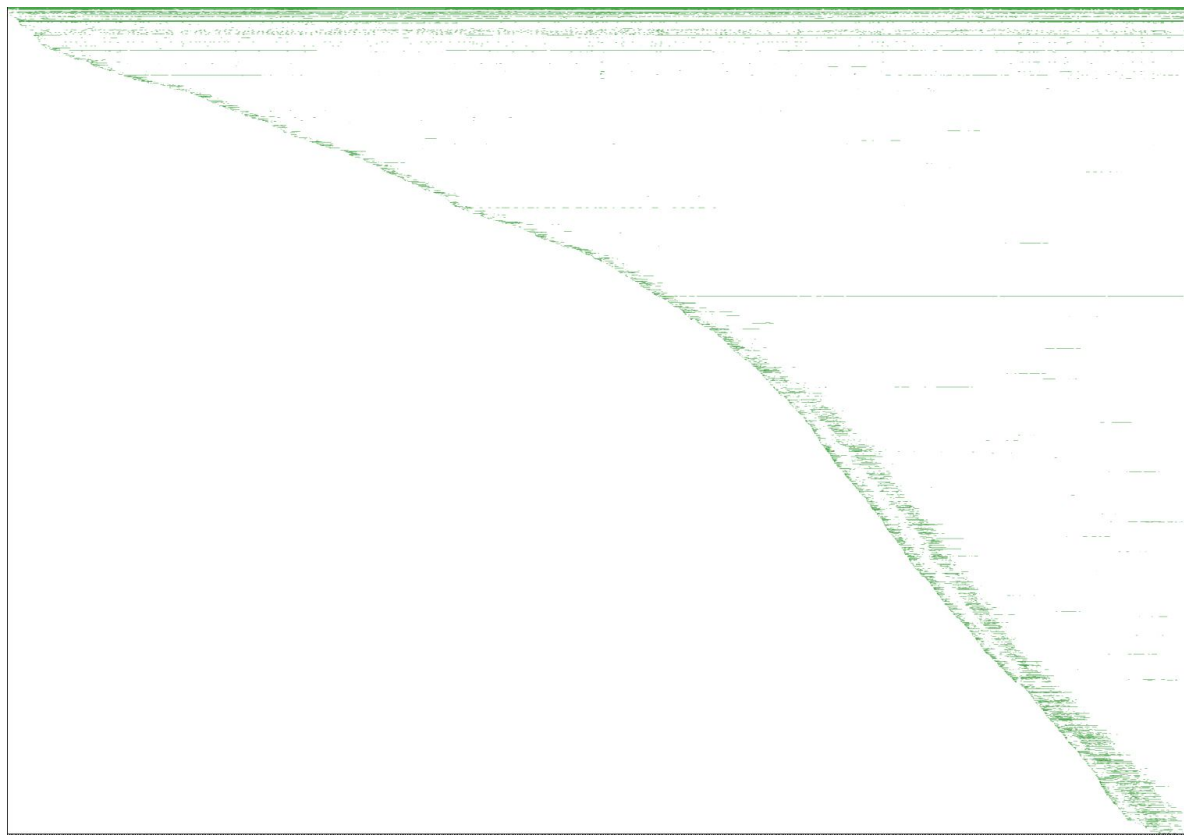
During the previous two national elections in Denmark, the DemTech project conducted two pilot studies regarding the measurement and analysis of the amount of time voters spent waiting in line. The partners for this project were University of Copenhagen, Department of Political Science and the municipality of Copenhagen. We continue piloting this technology also in 2015 in Aarhus and Copenhagen. The goals are



- ✓ to collect data from polling stations previously studied, to compare and statistically analyze them,
- ✓ to experiment with precise placement of the sensors, to be able to understand better where voters mingle. Queues usually form for registration, but also when waiting to fill out the ballot form, or for when casting it,
- ✓ to extend the pilot to other polling stations for the purpose of comparison.

As an example of what kind of results we achieved, consider the graph depicted below. The horizontal axis denotes time. The

leftmost point refers to 8am when the polling station opened, and the right most time to 6pm when the polling station closed. Each unit corresponds to one minute. The vertical axis denotes unique WIFI enabled devices. The topmost line refers to the device seen first, the bottommost line to the device seen last. The solid green lines in the upper half of the picture refer to permanently WIFI routers (installed in the school where the election took place), and likely the phones of the polling station staff. This graphs allows us to conclude that the maximal waiting time was around 30 minutes.



Origin at 1900-01-01 09:29:05, 1 small tick = 60000.0ms



ESOF scientific session on Democracy in the Digital Age

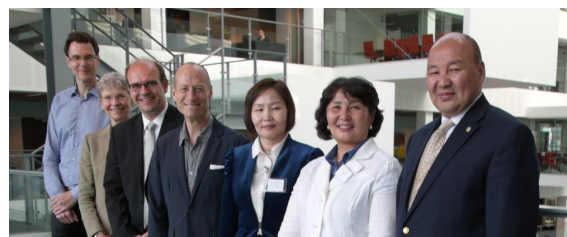
In June 2014, DemTech organized a scientific session at ESOF 2014 on the topic Democracy in the Digital Age: Computational Aspects of Voting Systems.

Computers play an increasingly important role in elections. They are often used to modernise and optimise administrative processes. But perhaps more importantly and much less discussed in public, they have the potential to improve the voting system itself (i.e. the way in which votes are translated into an election result). Since 2000, all but 11 countries held national elections in the world and many post-conflict and developing countries are currently in the process of creating their individual voting processes. We will focus on the computational aspects of voting systems and discuss how computers can help to develop voting systems and handle their complexities. We addressed four discussion areas: (1) problematic properties of modern electoral systems, such as strategic voting; (2) local circumstances,

traditions etc. that need to be taken into consideration; (3) developing countries that are building up novel electoral processes; and (4) how computers can help manage the complexities of voting schemes.

Danish Elections, Trust and Technology

In May 2014, DemTech organized the third DemTech Workshop on Danish Elections, Trust, and Technology for the Mongolian Election Commission Meeting 2014. We had presentations by Associate Prof. Carsten Schürmann (Principal Investigator DemTech), Mrs. Altanjargal Batnyam, (Member and General Secretary, General Election Commission of Mongolia), Assistant Prof. Nina Boulus-Rødje (ITU), Associate Prof. Randi Markussen (ITU), Prof. David Basin (ETH Zurich), and Prof. Philip Stark (University of California, Berkeley).



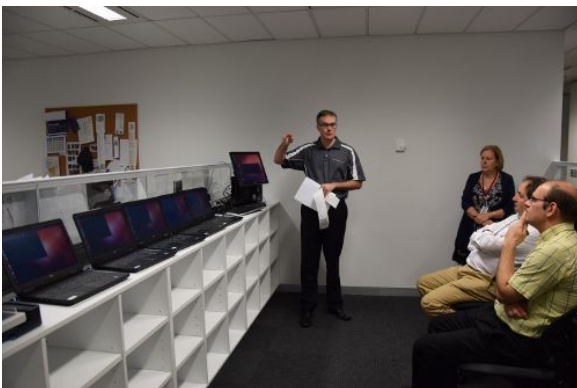
On the second day, we were invited to the town hall in Frederiksberg (who is a partner in DemTech) to observe voting and counting activities.



Election in Australia

In November 2014, DemTech's Carsten Schürmann and Jari

Kickbusch attended the shuffling and decryption ceremony at the Victoria Electoral Commission (VEC), Melbourne, Australia, today. More than a 1000 electronic votes were shuffled, decrypted and printed to be included in the count for the Victoria State Election. DemTech audited the election system used by Vec (the report is accessible online).



EVOTE conference in Bregenz

Several members of DemTech participated in October 29-31 in the 6th International Conference on Electronic Voting. EVOTE is considered one of the leading international events for e-voting experts, which provides a forum for interdisciplinary and open discussion of all issues related to electronic voting, from both a theoretical perspective

and a practical one. The conference was held in the beautiful renaissance castle of Hofen, at Lochau/Bregenz, on the shores of the Lake Constance in Austria. This edition gathered around 100 participants from 33 different countries, including practitioners, decision makers, vendors and researchers. In a session devoted to Trust in Electronic Elections, Randi, Lorena and Carsten presented their interdisciplinary work "Trust in Internet Election: Observing the Norwegian Decryption and Counting Ceremony". The paper, published in the corresponding proceedings, discusses from a pragmatic approach to trust how witnessing is brought about in the public event that took place within the internet voting trial of the Norwegian parliamentary elections of 2013, in which the electronic votes were decrypted and counted in front of an audience.

Prior to the main conference, a one-day PhD Colloquium also took place in the same venue, where Olivier had the opportunity to discuss his ongoing research on the relation between e-voting and election observation.

PhD Course on Code Scanning

In April 2014, DemTech organized a PhD course on Code Scanning. This course was intended for PhD students and advanced Master students and it was



designed to give an introduction to formal methods, teach the basics of code scanning theory, and allow students to gain first-hand experience with the state of the art code scanners. Code scanners are tools that inspect source code automatically for bugs, security problems and other issues. They are often used to evaluate software used in safety critical systems. Contingent on our ability to secure licenses, we discussed five different tools, such as Coverity, Fortify, Code Sonar, AppScan, and FindBugs. The course was organized in two parts. The first part took place in April, where the organizers gave several lectures about the formal underpinnings of code scanners. During the last lecture we presented some sample code, and assigned (groups of) students to tools.

Velux Visiting Professor

David Basin from ETH Zurich was visiting the DemTech project in the Fall of 2013 and Spring of 2014 from a grant by the Velux Foundation. We are looking forward to having Prof. Peter Ryan, University of Luxemburg, and Prof. Philip Stark, University of California, Berkeley, visit us in 2015 and 2016.



Participation in events and conferences

October 2014

Carsten Schürmann participated at the ICT Proposals' Day and event organized by the European Commission that focuses on the Horizon 2020 Work Programme 2015 in the field of Information & Communication Technologies. The goal of this participation was to raise awareness for DemTech activities among the H2020 programme managers.

August 2014

Carsten Schürmann was one of four experts invited to the NemId Visionarium at Version2, discussing the next generation of Denmark's national ID infrastructure.

June 2014

Democracy and technology seminar: Center for Health and Society (CSS) in Copenhagen arranged a seminar today on democracy and technology. Both Alex Halderman and Carsten Schürmann from DemTech gave talks.

April 2014

DemTech retreat at the Dragør Badehotel. We discussed the nature of trust from different angles: Philosophy, Social Technology Studies, Mathematics, and Computer Science.



Publications

Gad, C. and S. Dalsgaard 2015. *Digital Optimizing*. Tidsskriftet Antropologi 70: 153-169.

Boulus-Rødje N. and Bjørn P. (2015). *Design Challenges in Supporting Distributed Knowledge: An Examination of Organizing Elections*. ACM CHI Conference on Human Factors in Computing Systems, 18-23 April, 2015. Seoul, Republic of Korea. DOI: 10.1145/2702123.2702458

Michael Clouser, Robert Krimmer, Henrik Nore, Carsten Schürmann, Peter Wolf (2014). *The Use of Open Source Technology in Elections*. International IDEA.

Schürmann, C., Beckert, B., Gore, R., Borner, T. & Wang, J. (Apr 2014). *Verifying Voting Schemes*. Journal of Information Security and Applications. 19, 2, p. 115-129

Taus Brock-Nannestad, Nicolas Guenot, Agata Murawska and Carsten Schürmann (2014). *Hybrid Extensions in a Logical Framework*. LFMTTP'14.

Taus Brock-Nannestad and Nicolas Guenot (2014). *Cut Elimination in Multifocused Linear Logic*. LINEARITY'14.

Nicolas Guenot and Lutz Straßburger (2014). *Symmetric Normalisation for Intuitionistic Logic*. CSL/LICS'14.

Kaustuv Chaudhuri and Nicolas Guenot (2014). *Equality and Fixpoints in the Calculus of Structures*. CSL/LICS'14.

Marco Carbone, Fabrizio Montesi, and Carsten Schürmann. *Choreographies, logically*. In Paolo Baldan and Daniele Gorla, editors, Proceedings of the 25th International Conference on Concurrency Theory (CONCUR'14), pages 47–62, Rome, August 2014. Springer Verlag LNCS 8704.

Randi Markussen, Lorena Ronquillo, and Carsten Schürmann. *Trust in internet election — observing the norwegian decryption and counting ceremony*. In Robert Krimmer and Melanie Volkamer, editors, Proceedings of the 6th International Conference on Electronic Voting, Lochau/Bregenz, Austria, October 2014. IEEE.

Jorge Luis Sacchini, Iliano Cervesato, Frank Pfenning, and Carsten Schürmann. *Mode checking in the concurrent logical framework*. Technical Report CMU-CS-14-134 and CMU-CS-QTR-123, Carnegie Mellon University, 2014.