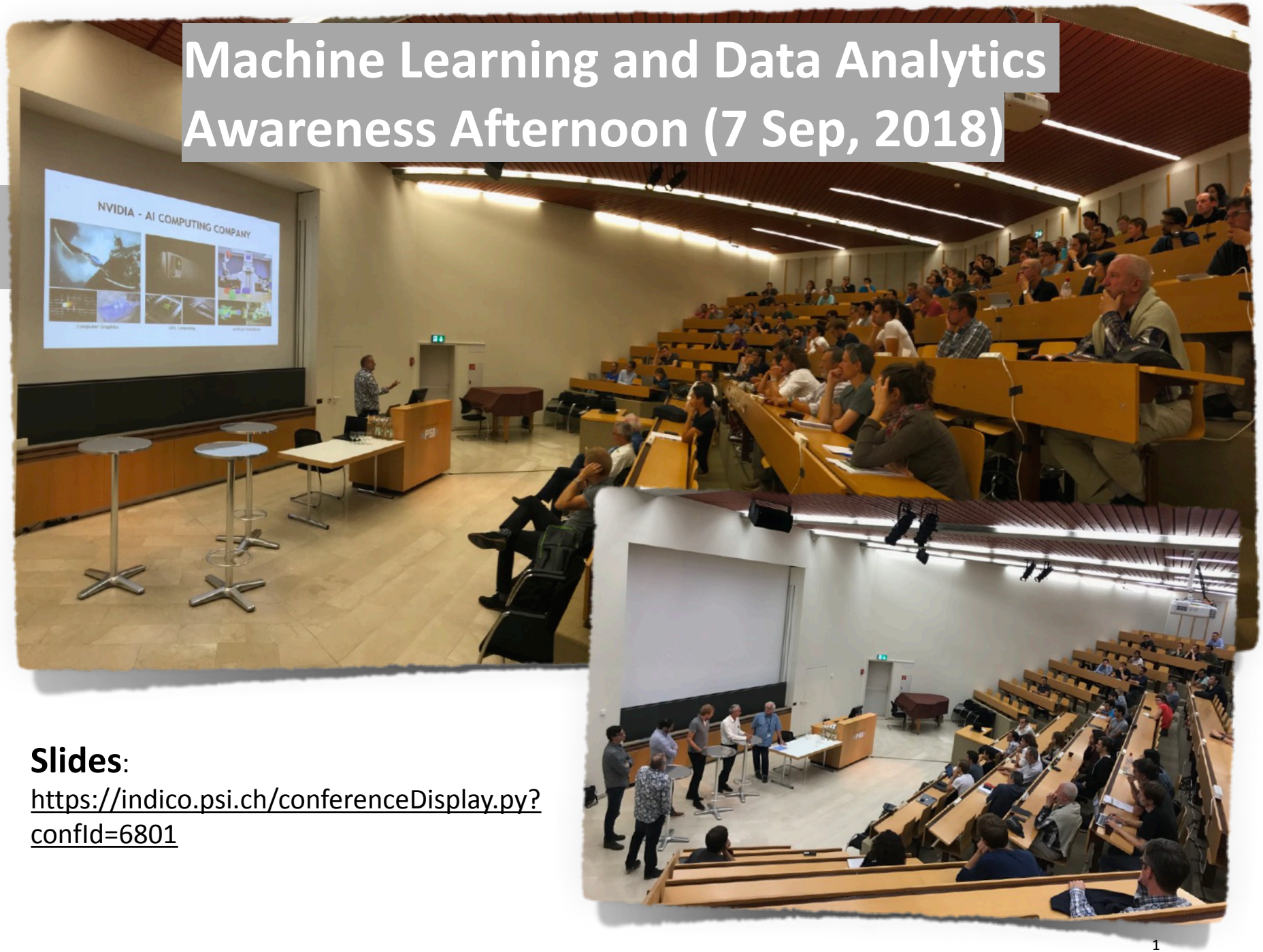
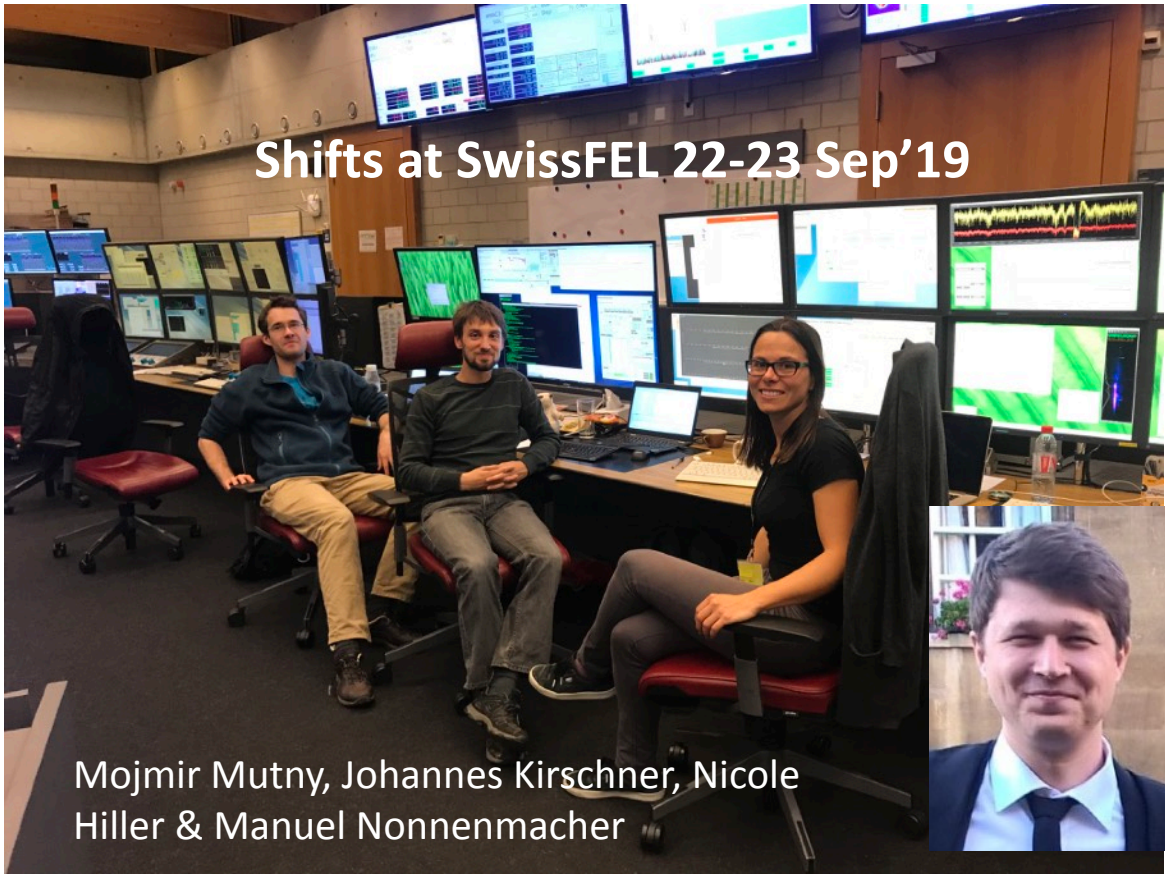
Machine Learning and Data Analytics Awareness Afternoon (7 Sep, 2018)



Slides:
https://indico.psi.ch/conferenceDisplay.py?confId=6801

News from SwissFEL - ML Based Machine Optimization



- Had a shift and tested 3-stage tuning strategy
    1. Single parameter scans to determine hyper parameters and safe-set
    2. One dimensional dropout UCB
    3. Greedy optimisation in vicinity of opt

- Used this to tune the electron trajectory through the undulators and optimise the FEL pulse energy

S_OP_ML.ui

SwissFEL - Machine Learning Based Optimization 23.09.2018 13:39:55 CEST

Status

Run	1	Step #	365	Algorithm	OneDim_Dropout_UCB	Start time	13:29:45
Status	ON	Step type	NA	CB-Cov.	nan		

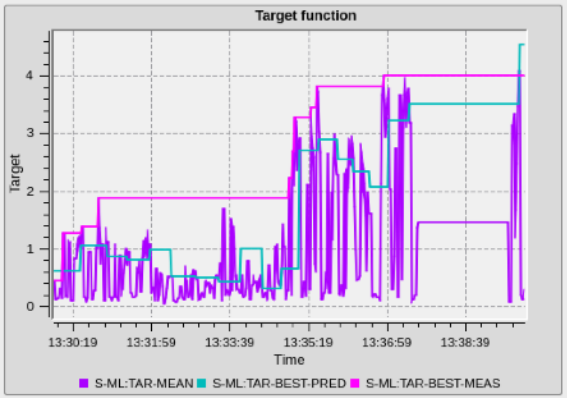
Target

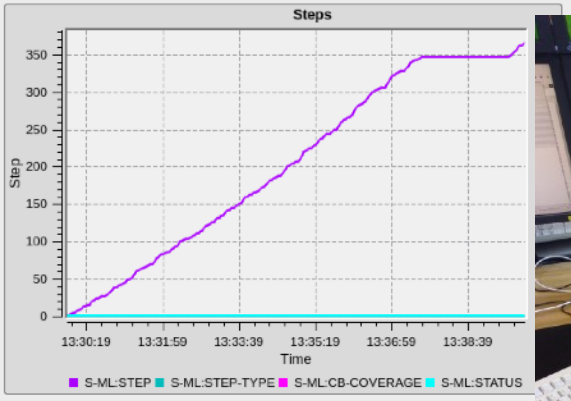
Mean	STD	Best predicted	Best measured
4.5378	0.0417	4.5437	4.5378

Knobs

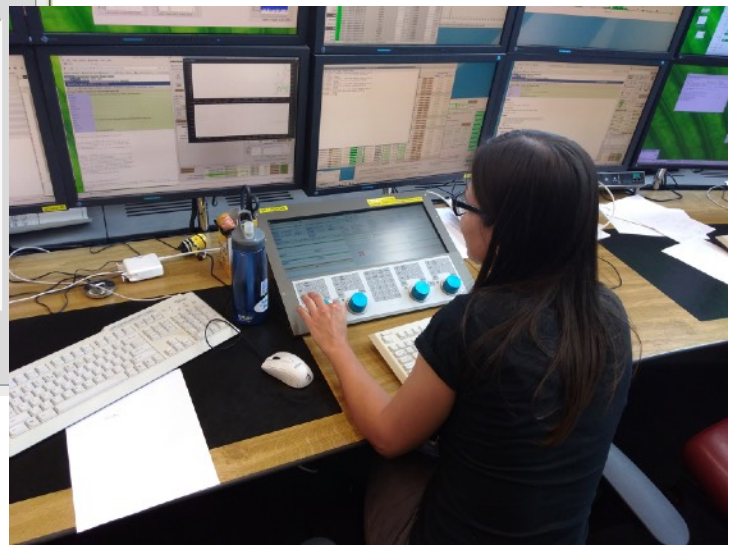
Number of knobs 5

	Knob	Start value	Best predicted	Best measured
01	SARUN06-DBPM070:X-REF-FB	-0.002530	0.025777	0.022479
02	SARUN07-DBPM070:X-REF-FB	0.020660	0.023513	0.010414
03	SARUN08-DBPM070:X-REF-FB	0.000898	0.004886	0.005072
04	SARUN09-DBPM070:X-REF-FB	0.000000	-0.009140	-0.002645
05	SARUN10-DBPM070:X-REF-FB	-0.016220	0.002087	0.001852
06	-	nan	nan	nan
07	-	nan	nan	nan
08	-	nan	nan	nan
09	-	nan	nan	nan
10	-	nan	nan	nan
11	-	nan	nan	nan
12	-	nan	nan	nan
13	-	nan	nan	nan
14	-	nan	nan	nan
15	-	nan	nan	nan
16	-	nan	nan	nan
17	-	nan	nan	nan
18	-	nan	nan	nan
19	-	nan	nan	nan
20	-	nan	nan	nan
21	-	nan	nan	nan
22	-	nan	nan	nan
23	-	nan	nan	nan
24	-	nan	nan	nan
25	-	nan	nan	nan
26	-	nan	nan	nan
27	-	nan	nan	nan
28	-	nan	nan	nan
29	-	nan	nan	nan
30	-	nan	nan	nan
31	-	nan	nan	nan
32	-	nan	nan	nan





- Can easily test and compare different algorithms with the framework
- Did benchmarking of several algorithms (also manual tuning)
- Ran tests with up to 12 knobs simultaneously and could come back to optimum when manually detuning machine



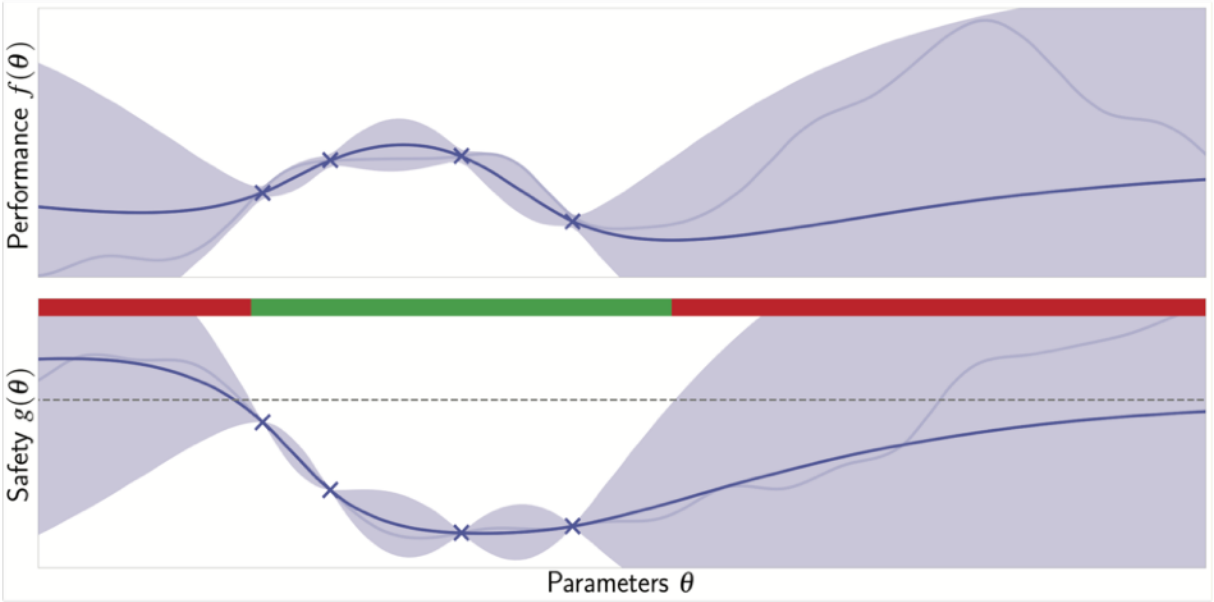
Trying to be faster with manual tuning of 4 knobs (failed)

- Want to turn it into a tool to be used from the control room

Announcements

- Luncheons on Indico: https://indico.psi.ch/categoryDisplay.py?categId=346
- Doodle to sign up: https://doodle.com/poll/gbhus7f9evxn6bpv
- Next Luncheon Thu 8 Nov, Thu 20 Dec
- Mailing list: ml@lists.psi.ch sign up: https://psilists.ethz.ch/sympa/info/ml

How Does Safe Bayesian Optimization Work?



- X are evaluation points, for each evaluation point the performance (e.g. FEL pulse energy) is measured and the model using Gaussian processes is updated
- Additionally, the safety function (e.g. losses in the undulators) is evaluated and its model is also updated -> taking into account the uncertainties of the safety function this defines the safe-set marked in green
- The next evaluation point is selected from within the safe-set to either
  - yield the highest potential value of the performance function (exploitation step)
  - or evaluate at a location close to the boundary of the safe-set in order to increase its boundaries and not end up in a local optimum (exploration step)