Data Analysis Session

Worldwide non-commercial space launches correlates with Sociology doctorates awarded (US)

(Thanks, Jochem, for reminding me of this amazing resource.)
T. Boltz

Analysis of Micro-Structure Dynamics
Different Bursting Regimes: Exemplary Bunch Currents

$bunch$ current (mA)

frequency (kHz)

$\bar{I}_{saw}$

$\bar{I}_{reg}$

spec. int. (arb. unit)

$10^0$

$10^{-2}$

$10^{-4}$

$10^{-6}$

$10^{-8}$

Tobias Boltz – ML Application on the Investigation of the Micro-Bunching Instability | LAS, KIT

March 2, 2018 9/22
T. Boltz

Sawtooth Bursting Regime

Referenced Cluster Centers, $I_{\text{Saw}} = 1.15 \text{ mA}$, $k = 4$

Charge density diff. $(10^{-1} \text{ pC/ps})$

Longitudinal position (ps)

k-means clustering for bunch micro-structure
Discovery potential from careful analysis of data pulled from ML?
Goal: improved measurement of emittance/volume reduction.
KDE works on simulation, and we’re all excited to see the data now.
Conclusion

- KDE based measurements:
  - Provide a detailed diagnostics of the muon beam traversing a material
  - Proven to be robust against beam loss
- Re-weighter routine:
  - Removes correlations in the beam
  - Further investigation in MC and data in progress
- Future supervised learning:
  - Expected cooling performance as output data
  - Supervised re-weighting techniques (e.g. boosted decision trees)
- MICE has gathered great amount of data:
  - Application of KDE to data on-going
Visualisation – correlation matrix

- Extraction and RF in ring cyclotron
- Trim coils in ring cyclotron
- Phase and loss monitors in ring cyclotron
- Loss monitors in targets beamline
- Interlocks

J. Snuvernink
Summary and Outlook

- Simple methodology for data mining
- Personal experience on HIPA data shown
  - Data preparation step most tricky
  - Discuss with controls group how this can be improved
  - Data normalisation needed for ML
- Some simple visualisation plots that can guide for large amounts of data
- Simple regression model
  - Reduce false positive rate
  - Add predictive power (RNN)

Comprehensive discussion of data preparation – very useful!
Topics during general discussion:

• What do operators need/want? Can we give them tools based on visualization & feature reduction?
• We don’t have as much data as HEP. ML is greedy for data, but do we have the necessary infrastructure & culture for “big data”?
• How to connect with other communities, e.g. theorists?
• Top-down vs bottom-up motivation for ML
Congratulations to Jochem!

Want to say a few words on what you did for this result?