2D η-correction by a Neural Network

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Lukáš Malina, Peter Kodyš, Peter Kvasnička

Charles University in Prague
Institut of Particle and Nuclear Physics

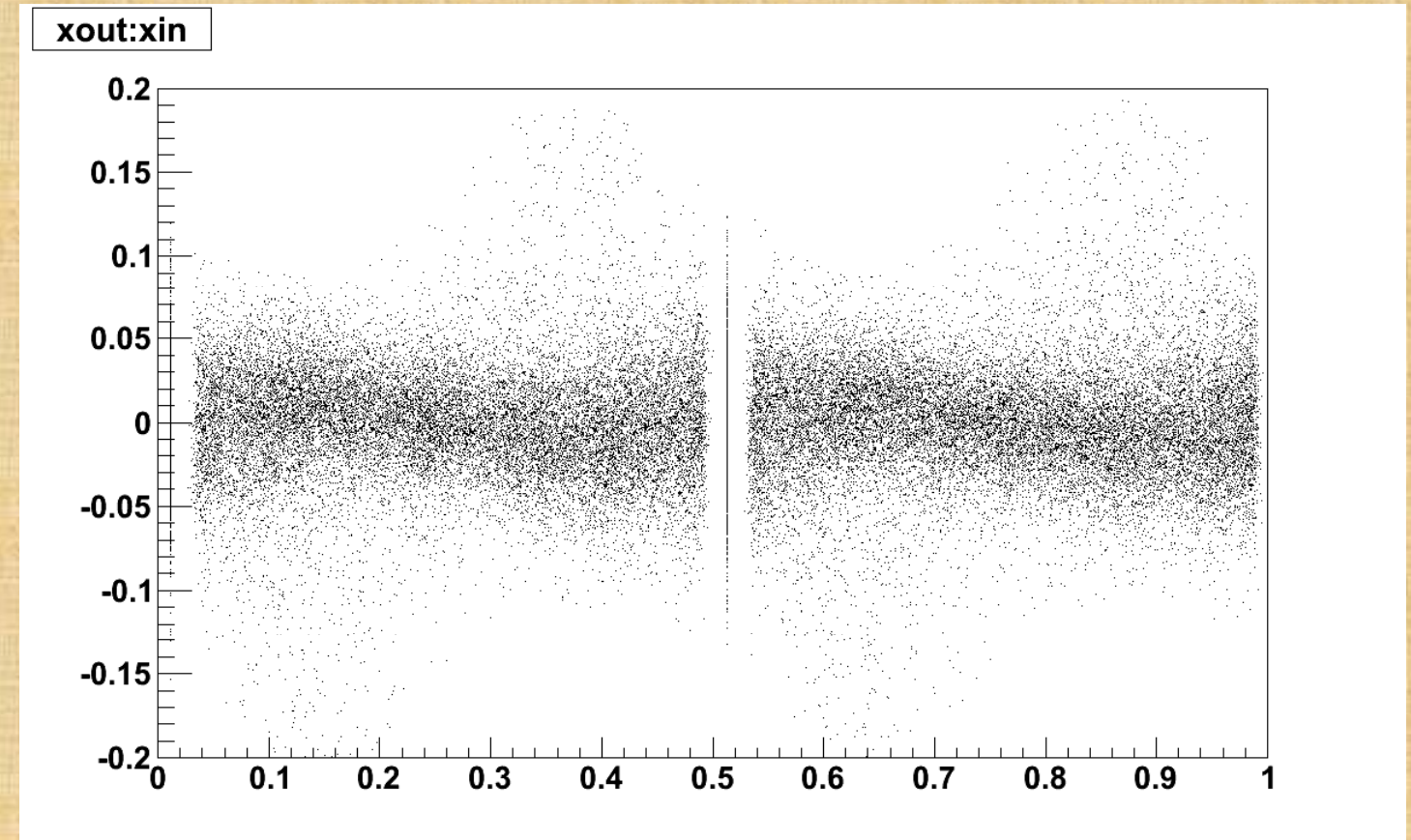
Why a Neural Network?

- **η-correction in 2D is not straightforward**
  - **2 1D η –correction perform well, but there are 2D features they don't see**
  - **A simple NN can be a handy representation off a 2D η–correction function**
- **Procedure:**
  - **Train the network using CoG from hit reconstruction on input and track intersections on output.**
  - **Use the network to predict corrected hit positions based on CoG positions.**

Methods

- ROOT Class TMultiLayerPerceptron
- Learning Methods:
  - BFGS, Stochastic
- Used types of neurons:
  - input – inactive
  - hidden – sigmoidal or Gauss
  - output – linear
- Learning data: from Beam test 2009
  - Input: CoG position modulo double pitch
  - Output: (track intersection – CoG)
- Different sizes of networks were tested

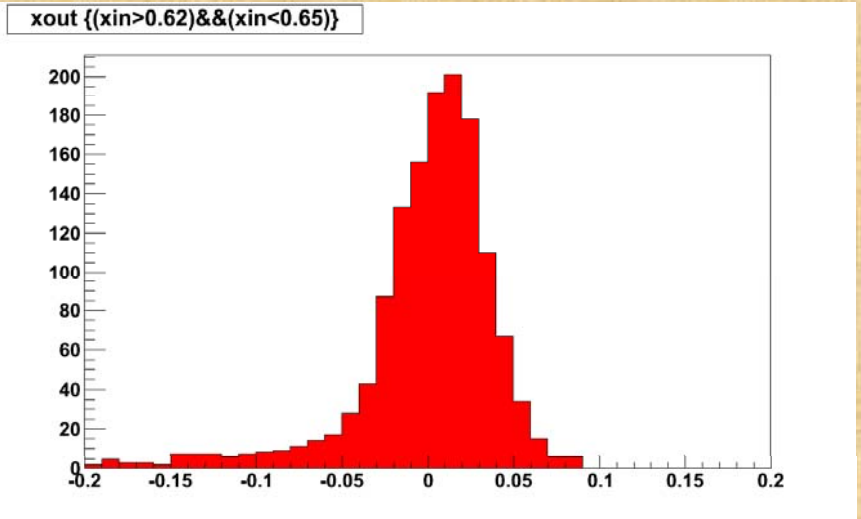
Results

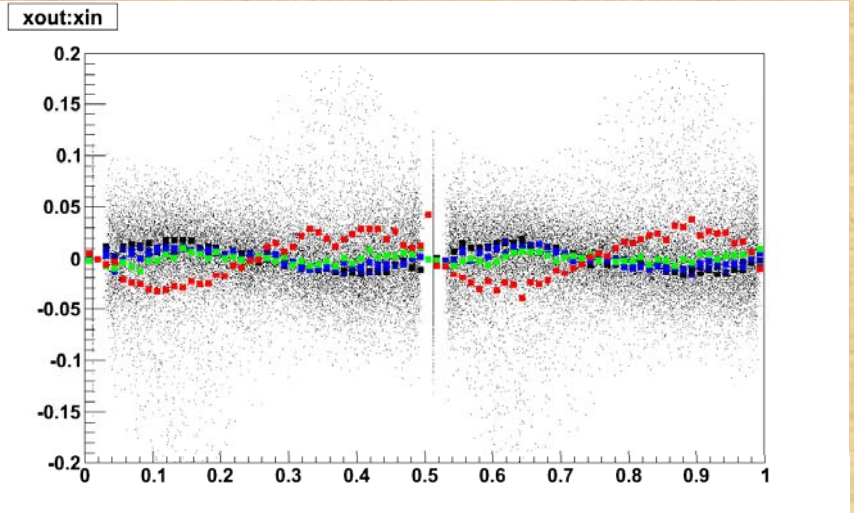


•The networks don't work: We tested various network topologies and neuron types with the same results.

•Residuals in dependence on position in double pixel show that the MPV is different from mean because of tailed distributions.

Results





•The error distribution is assymetric and the tails offset network predictions.

•**Hypotesis: this could be due to energy dependence.** We use four equidistant quantiles to split data by energy

• Residual profiles for different energies are in the row from the lowest one (black, dark blue, light blue, green and red for the highest energy)

•Spliting by energy improves residuals: for the same network geometry:

- •we get 1.9 µm in x-axis instead of 2.4 µm
- •we get 1.7 µm in y-axis instead of 2.0 µm

Outlook and Conclusions

- **Results from NN can only be made as good as non-parametric estimates of the η-correction function when split by energy.**
- **This is for practical reasons: we used the standard (that is non-robust) error function in training, while medians were used in analysis.**

- **This is the simpler part, our ultimate goal is to use NN for clustering and hit reconstruction from digits.**

Thank you for your attention