

Results on classification of simulation samples

Using Deep Learning

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Overview of the dataset

Type of event	Energy	Number of Samples
Nuclear Recoil	1 keV	1000
Nuclear Recoil	3 keV	1000
Nuclear Recoil	6 keV	1000
Nuclear Recoil	10 keV	1000
Nuclear Recoil	30 keV	1000
Nuclear Recoil	60 keV	1000
Nuclear Recoil	100 keV	1000
Electron Recoil	1 keV	1000
Electron Recoil	3 keV	1000
Electron Recoil	6 keV	1000
Electron Recoil	10 keV	1000
Electron Recoil	30 keV	1000
Electron Recoil	60 keV	1000
Electron Recoil	100 keV	1000
Noise	0 keV	1000

Overview of the samples

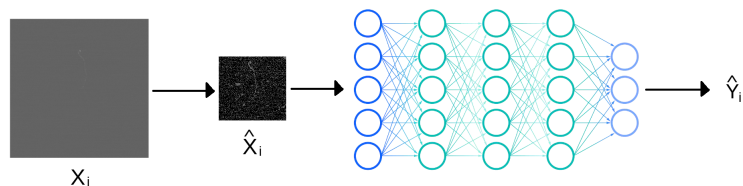


Size: 2306 × 2306 pixels

Classification problem

Formulated with 15 classes

$C = \{NR1, NR3, NR6, NR10, NR30, NR60, NR100, ER1, ER3, ER6, ER10, ER30, ER60, ER100, Noise\}$



- X_i : Input matrix
- Y_i : Corresponding class
- $Y_i \in C$
- \hat{X}_i : Pre-processed input
- \hat{Y}_i : Estimated class
- $\hat{Y}_i \in C$

Classification problem

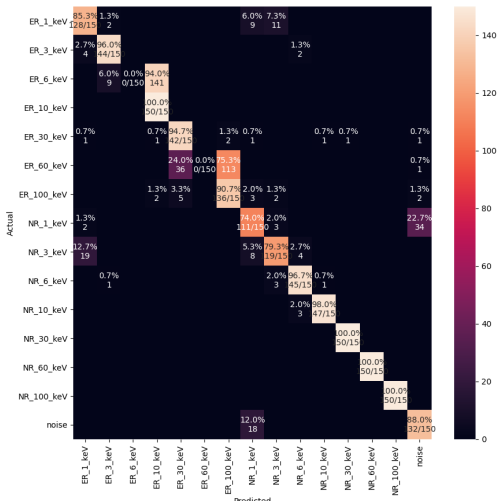
Formulated with 15 classes

Sample Subset	Classes						
	ER1	ER3	ER6	ER10	ER30	ER60	ER100
Training	765	765	765	765	765	765	765
Validation	85	85	85	85	85	85	85
Testing	150	150	150	150	150	150	150

Sample Subset	Classes							
	NR1	NR3	NR6	NR10	NR30	NR60	NR100	Noise
Training	765	765	765	765	765	765	765	765
Validation	85	85	85	85	85	85	85	85
Testing	150	150	150	150	150	150	150	150

Classification problem

Formulated with 15 classes

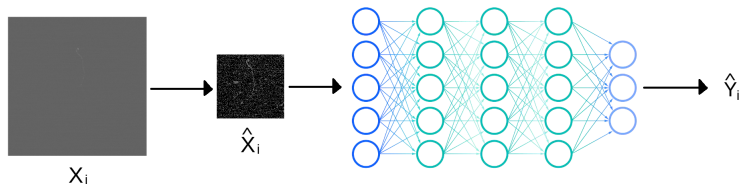


Classification + Regression problem

Formulated with 3 classes + 1 continuous estimator

$$C = \{NR, ER, Noise\}$$

$$E = \{x \in \mathbb{R}; x \geq 0; x \leq 100\}$$



- X_i : Input matrix

- $Y_i : \langle y_i^1, y_i^2 \rangle$

- $y_i^1 \in C$

- $y_i^2 \in E$

- \hat{X}_i : Pre-processed input

- $\hat{Y}_i : \langle \hat{y}_i^1, \hat{y}_i^2 \rangle$

- $\hat{y}_i^1 \in C$

- $\hat{y}_i^2 \in E$

Classification + Regression problem

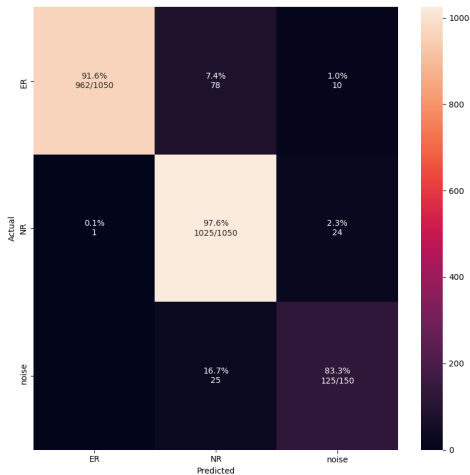
Formulated with 3 classes + 1 continuous estimator

Sample Subset	Classes		
	ER	NR	Noise
Training	5355	5355	765
Validation	595	595	85
Testing	1050	1050	150

Sample Subset	Energy Estimator							
	0	1	3	6	10	30	60	100
Training	765	1530	1530	1530	1530	1530	1530	1530
Validation	85	170	170	170	170	170	170	170
Testing	150	300	300	300	300	300	300	300

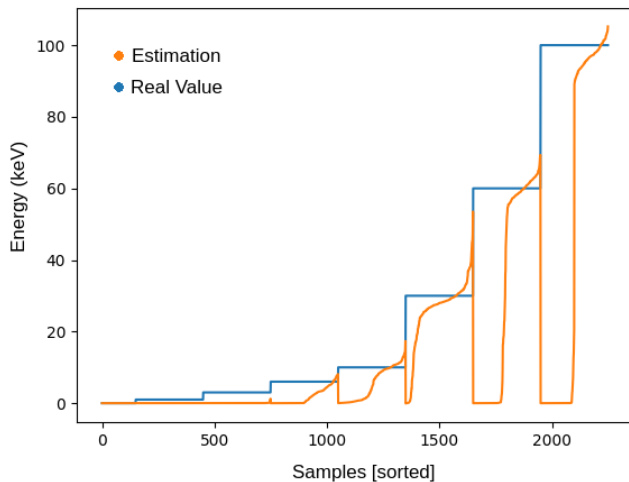
Classification + Regression problem

Formulated with 3 classes + 1 continuous estimator



Classification + Regression problem

Formulated with 3 classes + 1 continuous estimator



Further work

- Explore different preprocessing techniques
- Explore different experimentation variables (model, learning rate, dropout)
- Compare results with experimental data vs simulation data
- Evaluate the segmentation capabilities on multi-event samples
- Check the accuracy of the Energy estimation