0.1 Comparison of Wang-Landau results for random Statistical Images

```python
import numpy as np
from scipy import interpolate, special
import os, h5py, hickle
import matplotlib.pyplot as plt
import pprint
```

```python
import sys
if 'src' not in sys.path: sys.path.append('src')
import wanglandau as wl
from statistical_image import exact_bw_gs
import canonical_ensemble as canonical
from intensity_entropy import intensity_entropy
```

```python
datadir = 'data/random-images'
paths = [os.path.join(datadir, f) for f in os.listdir(datadir)]
len(paths)
```

```
174
```

```python
with h5py.File(paths[0], 'r') as f:
    result = hickle.load(f)
    imp = result['parameters']['system']['StatisticalImage']
    N = len(imp['I0'])
    M = imp['M']
    Es = result['results']['Es'][:-1]
```

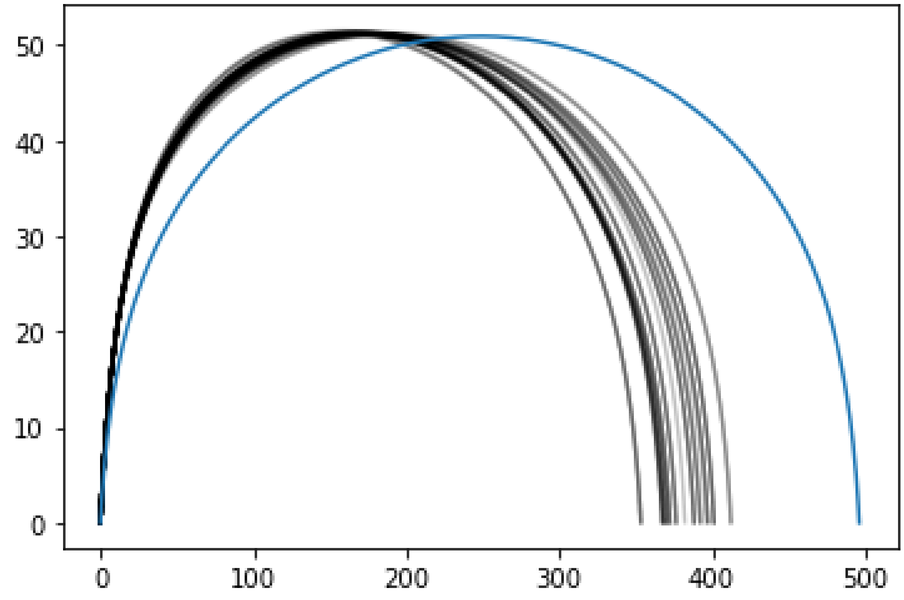
```python
pprint.pprint(result['parameters'])
```

```
{'log': True,
 'simulation': {'M': 496000000, 'eps': 1e-08, 'flatness': 0.2, 'logf0': 1},
 'system': {'StatisticalImage': {'I': array([ 5, 30,  3, 31, 31, 31, 31, 30, 22,  2,  0,  7,  4,  3, 30, 22]),
                                 'I0': array([29,  5, 29,  0,  3,  1,  3, 16,  4, 19, 29, 28, 23, 19,  3,  9]),
                                 'M': 31}}}
```

```python
def file_results(path):
    with h5py.File(path, 'r') as f:
        result = hickle.load(f)
        Es = result['results']['Es'][:-1]
        S = result['results']['S']
        return Es, S - min(S)
```

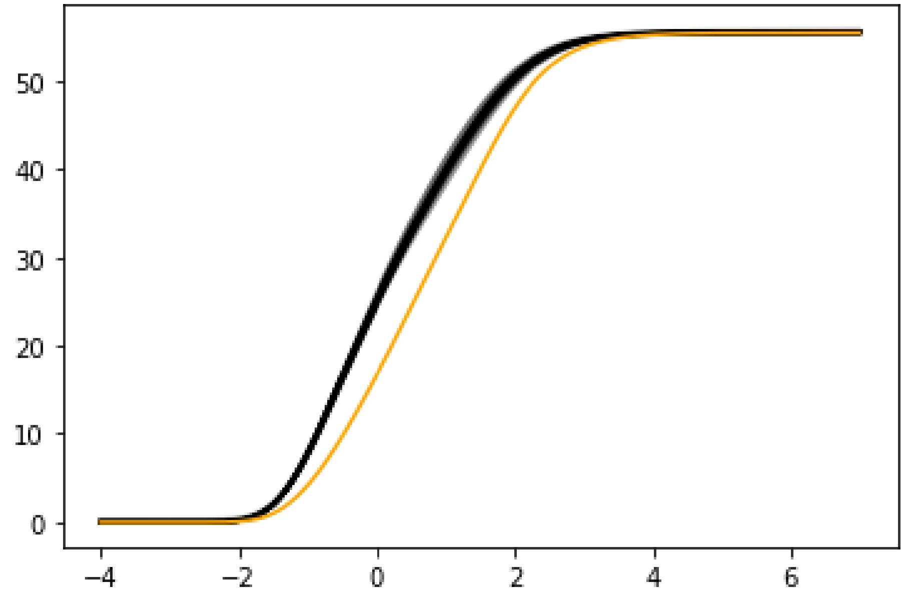
```python
xEs, xgs = exact_bw_gs(N, M)
xlng = np.log(xgs)
xens = canonical.Ensemble(xEs, xlng, 'Exact')
```

```python
for Es, S in map(file_results, paths):
    plt.plot(Es, S, 'black', alpha=0.05)
plt.plot(xEs, xlng);
```

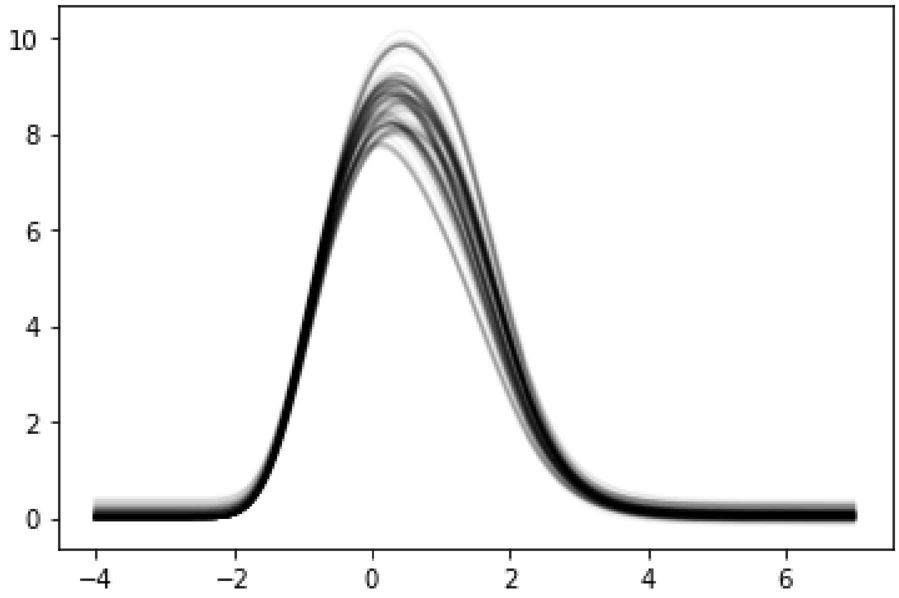


```
βs = np.exp(np.linspace(-7, 4, 500))
```

```
for Es, S in map(file_results, paths):
    ens = canonical.Ensemble(Es, S)
    plt.plot(-np.log(βs), ens.entropy(βs), 'black', alpha=0.05)
plt.plot(-np.log(βs), xens.entropy(βs), 'orange');
```



```
for Es, S in map(file_results, paths):
    ens = canonical.Ensemble(Es, S)
    plt.plot(-np.log(βs), ens.entropy(βs) - xens.entropy(βs), 'black', alpha=0.05)
```

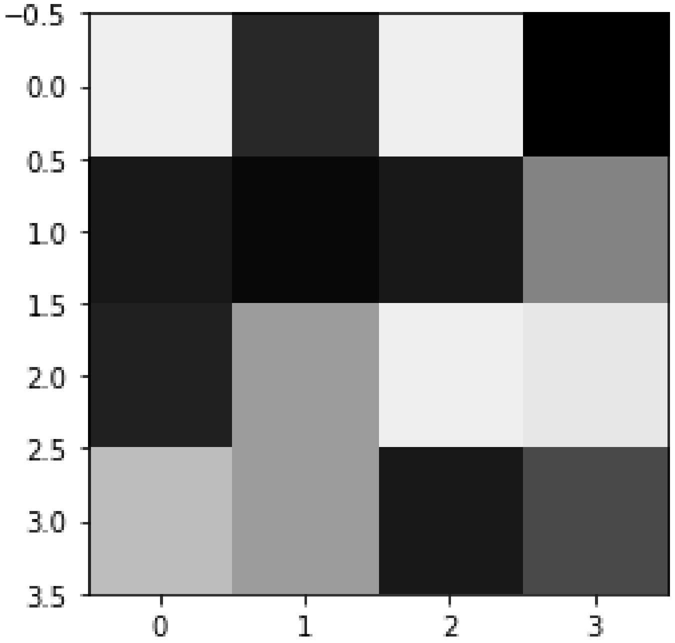


Is the canonical entropy related to the intensity entropy?

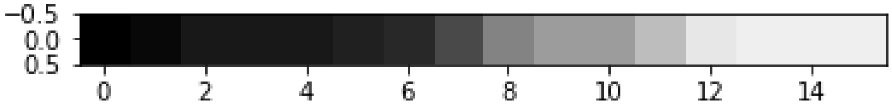
```
result['parameters']['system']['StatisticalImage']['I0']
```

```
array([29,  5, 29,  0,  3,  1,  3, 16,  4, 19, 29, 28, 23, 19,  3,  9])
```

```
plt.imshow(np.reshape(result['parameters']['system']['StatisticalImage']['I0'], (int(np.sqrt(N)), -1)),
↪  cmap='gray', vmin=0, vmax=M);
```



```
plt.imshow(np.reshape(np.sort(result['parameters']['system']['StatisticalImage']['I0']), (1, -1)),
↪  cmap='gray', vmin=0, vmax=M);
```



```
I0 = result['parameters']['system']['StatisticalImage']['I0']
```

```
intensity_entropy.intensity_entropy(I0, upper=M+1)
```

```
3.2806390622295662
```