Image Quality Assessment with Machine Learning

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We try to implement Image Quality Assessment (IQA) with machine learning in two ways - by Python:

- **Method1 - Full reference:**

  We apply the SVR to existing full reference objective IQA metrics,
  e.g. PSNR, SSIM, FSIM .etc (14 metrics)

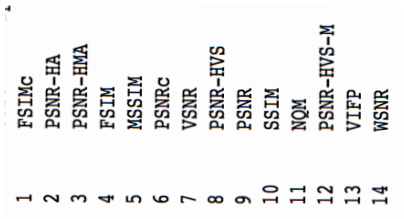
- **Method2 - No reference:**

  We apply the SVR to different features,
  e.g. BRISQUE spatial Characteristics (36 features)

Database:
The TID2013 - contains 25 reference images and 3000 distorted images (25 reference images x 24 types of distortions x 5 levels of distortions).

Process Diagram

Method 1 (Full reference)



1	FSIMc
2	PSNR-HA
3	PSNR-HMA
4	FSIM
5	MSSIM
6	PSNRc
7	VSNR
8	PSNR-HVS
9	PSNR
10	SSIM
11	NQM
12	PSNR-HVS-M
13	VIFP
14	WSNR

Training and Prediction Phase

3000 images

IQA Score [3000 X 7]

Regression SVR

MOS [3000 X 1]

Output data

Input data (select any 1~14 of metrics)

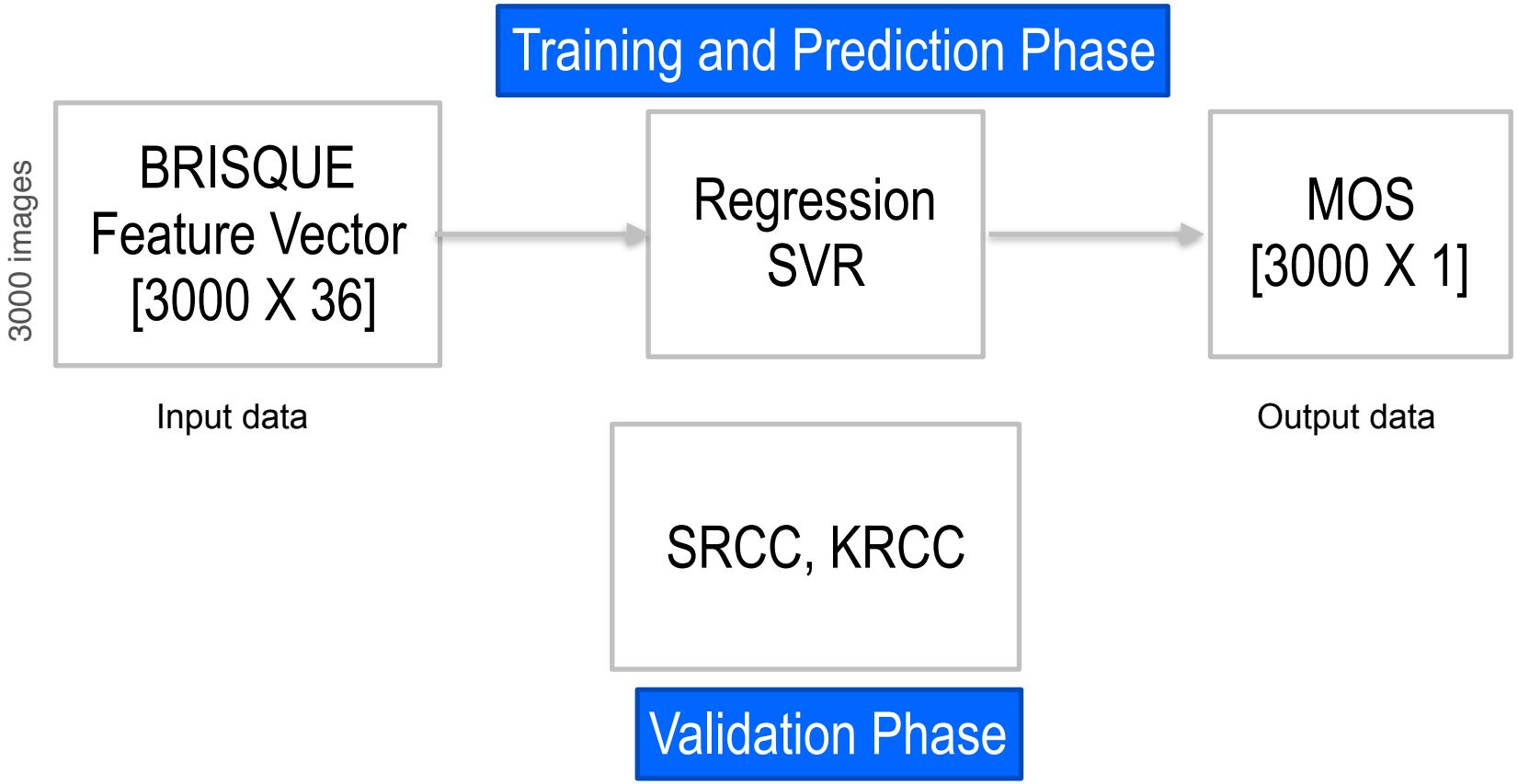
FSIMc,
PSNR-HA,
PSNR-HMA,
FSIM,
VSNR,
PSNRc
SSIM

SRCC, KRCC

Validation Phase

Process Diagram

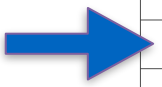
Method 2 (No reference)



Result

Method 1 (Full reference)

3000 images
7 IQA metrics



	Measures	Spearman Correlation (SRCC)	Kendall Correlation(KRCC)
1	Proposed Method1	0.893	0.726
2	FSIMc	0.851	0.667
3	PSNRHA	0.819	0.643
4	PSNRHMA	0.813	0.632
5	FSIM	0.801	0.630
6	MSSIM.	0.787	0.608
7	PSNRc	0.687	0.496
8	VSNR	0.681	0.508
9	PSNRHVS	0.654	0.508
10	PSNR	0.640	0.470
11	SSIM	0.637	0.464
12	NQM	0.635	0.466
13	PSNRHVSM	0.625	0.482
14	VIFP	0.608	0.457
15	WSNR	0.580	0.446

Compare with each of 14 full reference IQA metrics in TID2013 database, the Method1 is **better than any single of 14 objective IQA metrics**.

Result

Method 2 (No reference)

3000 images
36 BRISQUE features

		Measures	Spearman Correlation (SRCC)	Kendall Correlation(KRCC)
1	FR	FSIMc	0.819	0.643
2		PSNRHA	0.813	0.632
3		PSNRHMA	0.801	0.630
4		FSIM	0.787	0.608
5	NR	Proposed Method2	0.711	0.522
6	FR	MSSIM	0.687	0.496
7		PSNRc	0.681	0.508
8		VSNR	0.654	0.508
9		PSNRHVS	0.640	0.470
10		PSNR	0.637	0.464
11		SSIM	0.635	0.466
12		NQM	0.625	0.482
13		PSNRHVSM	0.608	0.457
14		VIFP	0.580	0.446
15		WSNR	0.580	0.446

Compare with the total of14 full reference IQA metrics in TID2013 database, the Method2 can rank **No.5 compared with other 14 FR measures**.

Spyder (Python 3.6)

/Users/bingxinhou/Documents/SCU/338VideoComptression/project

Editor - /Users/bingxinhou/Documents/SCU/338VideoComptression/project/Bing_code/ImageQualityProject_M1.py

ImageQualityProject_M1.py | IQProjectM2.py

```
31
32 import numpy as np
33 from sklearn.model_selection import train_test_split
34 from sklearn import linear_model
35 from sklearn import svm
36 from sklearn import neighbors
37 from scipy.stats import spearmanr,kendalltau
38 from numpy import array
39
40  # import TID2013
41
42 file="/Users/bingxinhou/Documents/SCU/338VideoComptression/TID2013/metrics_values/"
43 dict = { 1  :    'FSIMc.txt'     ,
44          2  :   'PSNRHA.txt'     ,
45          3  :    "PSNRHMA.txt" ,
46          4  :    "FSIM.txt"      ,
47          5  :    "MSSIM.txt"     ,
48          6  :    "PSNRc.txt"     ,
49          7  :    "VSNR.txt"      ,
50          8  :   "PSNRHVS.txt"     ,
51          9  :  "PSNR.txt"        ,
52          10 :  "SSIM.txt"        ,
53          11 :  "NQM.txt"         ,
54          12 :  "PSNRHVSM.txt"   ,
55          13 :  "VIFP.txt"        ,
56          14 :  "WSNR.txt"}
57
58 X=[]
59 for n in range(1,15):
60  X.append(np.loadtxt(file+dict[n]));
61 X=array(X).T
62
63 np.savetxt("FR_IQA_Scores.txt", X, delimiter=" ")
64
65 file_Y="/Users/bingxinhou/Documents/SCU/338VideoComptression/TID2013/MOS.txt"
66 Y = np.loadtxt(file_Y);
67
68
69
70 X_select = X[:,1:7];
71 Y_select = Y;
72
73
74  # machine learning
75 X_train, X_test, Y_train, Y_test = train_test_split(
76         X_select, Y_select, test_size=0.33, random_state=42)
77
78 classifiers = [
79         svm.SVR(),
80         linear_model.LinearRegression(),
81         neighbors.KNeighborsRegressor(5, weights='uniform')]
```

IPython console

Console 1/A

```
In [34]: runfile('/Users/bingxinhou/Documents/SCU/338VideoComptression/project/Bing_code/
ImageQualityProject_M1.py', wdir='/Users/bingxinhou/Documents/SCU/338VideoComptression/project/
Bing_code')
Method1: [0.89310481180391577, 0.72590768102664349]
FSIMc.txt[0.85101381864375858, 0.66694253407800108]
PSNRHA.txt[0.8186742553364641, 0.64330605654697948]
PSNRHMA.txt[0.81275143369643321, 0.63155884516986927]
FSIM.txt[0.80068941506904634, 0.62995722772179796]
MSSIM.txt[0.78715810281765197, 0.60791246438070778]
PSNRc.txt[0.68691156483341631, 0.49580552788343069]
VSNR.txt[0.68086397776213881, 0.50774894850061991]
PSNRHVS.txt[0.65356427491043556, 0.50766484070065808]
PSNR.txt[0.63951811578071238, 0.46997498476087401]
SSIM.txt[0.63697057567212623, 0.46355643653179435]
NQM.txt[0.63487351047678819, 0.46616967862349856]
PSNRHVSM.txt[0.62461234055127834, 0.48178094597290144]
VIFP.txt[0.60844558110375468, 0.45674823144244403]
WSNR.txt[0.57963723566619096, 0.44630563243394483]

In [35]: runfile('/Users/bingxinhou/Documents/SCU/338VideoComptression/project/IQProjectM2.py',
wdir='/Users/bingxinhou/Documents/SCU/338VideoComptression/project')
Method2: [0.71078216890944723, 0.52188844142576929]
PSNRHA.txt[0.8186742553364641, 0.64330605654697948]
PSNRHMA.txt[0.81275143369643321, 0.63155884516986927]
FSIM.txt[0.80068941506904634, 0.62995722772179796]
MSSIM.txt[0.78715810281765197, 0.60791246438070778]
PSNRc.txt[0.68691156483341631, 0.49580552788343069]
VSNR.txt[0.68086397776213881, 0.50774894850061991]
PSNRHVS.txt[0.65356427491043556, 0.50766484070065808]
PSNR.txt[0.63951811578071238, 0.46997498476087401]
SSIM.txt[0.63697057567212623, 0.46355643653179435]
NQM.txt[0.63487351047678819, 0.46616967862349856]
PSNRHVSM.txt[0.62461234055127834, 0.48178094597290144]
VIFP.txt[0.60844558110375468, 0.45674823144244403]
WSNR.txt[0.57963723566619096, 0.44630563243394483]

In [36]:
```

IPython console | History log

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