Technical Report
Stegnography final version

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REPORT SENSITIVITY

Does the report have any of the following sensitivities?

Intended for journal publication	YES
Results are incomplete	NO
Commercial/IP concerns	NO

Project Workflow:

- After that matameric approaches have not given good approaches, we have introduced decompsition technique, in wich we decompose the secret message to n sub-messages and hiding them in distributed areas of the image.
- To approve the benefit of hiding the secret bits in a distributed areas of the image, we returned back to the GA benchMark algorithm that is already superior over all other algorithms, and make it decompose the secret bits to n part and then hide them in non-continous areas of the image.

- Decomposition Pseudocode:

```
Input:
 imCover, secretMessage, n

Output:
stegno

Start:
1-  subMsgs = decompose(secretMessage,n)
2-  old_hiding_pixels = [ ]
3-  finalChrom = [ ]
4-  for subMsg in subMsgs
5-      [bestChrom,stegno,hidingPixels] = benchMarkAlgo(imCover, subMsg)
6-      old_hiding_pixels = [old_hiding_pixels  hidingPixels]
7-      imCover = stegno
8-      finalChrom = [finalChrom bestChrom]
9-  End for
End
```

- Modified cost function pseudocdoe

```
Input:
imCover,stegno,oldHidignPixels,hidingPixels
Output:
Cost
Start:
    1-  If any(ismember(hidingPixels, oldHidignPixels))
    2-      Cost = inf
    3-  Else
    4-      Cost = MSE(imCover,stegno)
    5-  End if
End
```

By implementing the above approach, we solve the problem of hyper search space that appears in the metameric approach, and the continuity problem that appears in the benchMark approach.

Execution:

Execution parameters:

	Population size	maxIter	Mutation rate/mutation ratio
All algorithm	50	50	Gaussian mutation with default matlab ga values for scale and shrink that are modified adaptivally using the generation number , default initial scale/shrink = 1/1

Other uniform params:

1- image dims scaling = [512,512]
2- Fitness function = -MSE

Secret Message:

Steganography is the practice of concealing a message within another message o
r a physical object. In computing/electronic contexts, a computer file, messag
e, image, or video is concealed within another file, message, image, or video.
 The word steganography comes from Greek steganographia, which combines the wo
rds steganos , meaning "covered or concealed, and -
graphia meaning "writing.The first recorded use of the term was in 1499 by Jo
hannes Trithemius in his Steganographia, a treatise on cryptography and stegan
ography, disguised as a book on magic. Generally, the hidden messages appear t
o be (or to be part of) something else: images, articles, shopping lists, or s
ome other cover text. For example, the hidden message may be in invisible ink
between the visible lines of a private letter. Some implementations of stegano
graphy that lack a shared secret are forms of security through obscurity, and
key-
dependent steganographic schemes adhere to Kerckhoffss principle.The advantage
 of steganography over cryptography alone is that the intended secret message
does not attract attention to itself as an object of scrutiny. Plainly visible
 encrypted messages, no matter how unbreakable they are, arouse interest and m
ay in themselves be incriminating in countries in which encryptionis illegal.W
hereas cryptography is the practice of protecting the contents of a message al
one, steganography is concerned with concealing the fact that a secret message
 is being sent and its contents. Steganography includes the concealment of inf
ormation within computer files. In digital steganography, electronic communica
tions may include steganographic coding inside of a transport layer such as a
document file image file program or protocol. Media files are ideal for stegan
ographic transmission because of their large size. For example a sender might
start with an innocuous image file and adjust the color of every hundredth pix

el to correspond to a letter in the alphabet. The change is so subtle that som eone who is not specifically looking for it is unlikely to notice the change.T he first recorded uses of steganography can be traced back to 440 BC in Greece , when Herodotus mentions two examples in his Histories. Histiaeus sent a mess age to his vassal, Aristagoras, by shaving the head of his most trusted servan t, "marking" the message onto his scalp, then sending him on his way once his hair had regrown, with the instruction, "When thou art come to Miletus, bid Ar istagoras shave thy head, and look thereon." Additionally, Demaratus sent a wa rning about a forthcoming attack to Greece by writing it directly on the woode n backing of a wax tablet before applying its beeswax surface. Wax tablets wer e in common use then as reusable writing surfaces, sometimes used for shorthan d.In his work Polygraphiae, Johannes Trithemius developed his so-called "Ave-Maria-
Cipher" that can hide information in a Latin praise of God. "Auctor Sapientiss imus Conseruans Angelica Deferat Nobis Charitas Potentissimi Creatoris for exa mple contains the concealed word VICIPEDIA.Modern steganography entered the wo rld in 1985 with the advent of personal computers being applied to classical s teganography problems.[7] Development following that was very slow, but has si nce taken off, going by a large number of steganography software availableAn i mage or a text can be converted into a soundfile, which is then analysed with a spectrogram to reveal the image. Various artists have used this method to co nceal hidden pictures in their songs, such as Aphex Twin in "Windowlicker" or Nine Inch Nails in their album Year ZeroIn communities with social or governme nt taboos or censorship, people use cultural steganographyhiding messages in i diom, pop culture references, and other messages they share publicly and assum e are monitored. This relies on social context to make the underlying messages visible only to certain readers.

BenchMark Decomposed specific parameters:

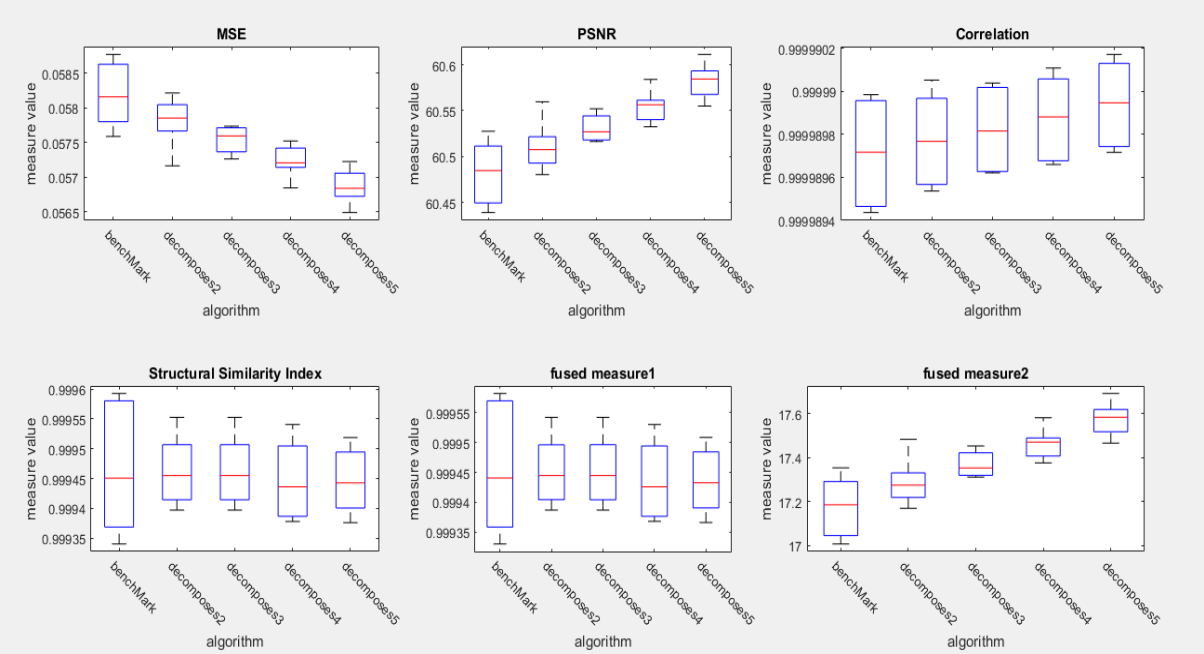
We have executed the previous approach using n=2 ,n=3,n=4 and n=5, this means that the message was decomposed to 2 and 3 subMsgs respectively

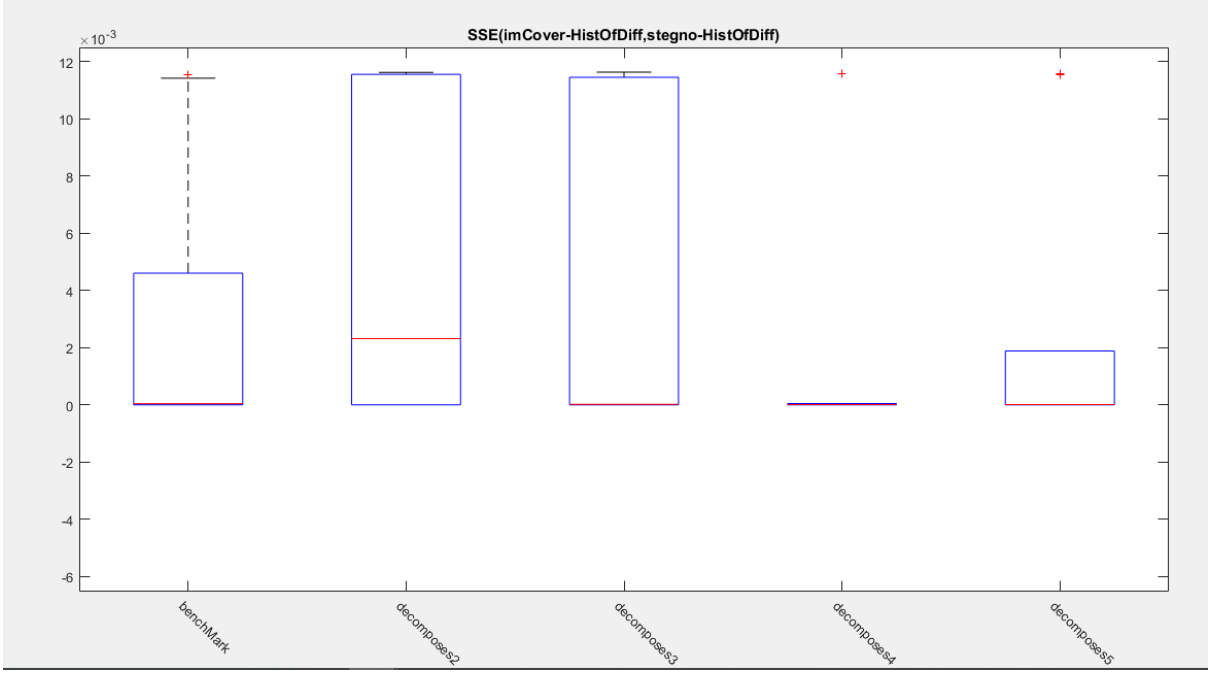
Used Measures:

1- MSE: mean of squared errors
2- PSNR
3- Correlation
4- Structural similiarity
5- Fused Measure1 = correlation * structural similiarity
6- Fused Measure2 = Fused Measure1 / MSE

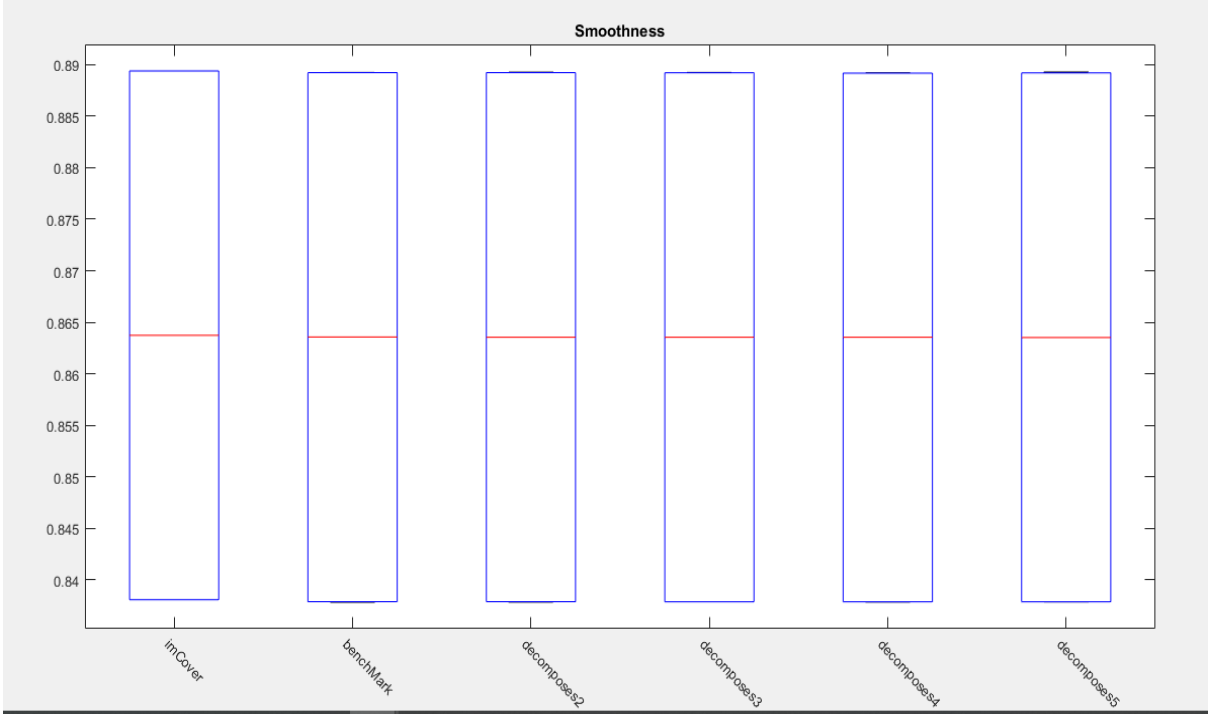
Results:

1-Chest Dataset within 2 images and 5 seeds for each image



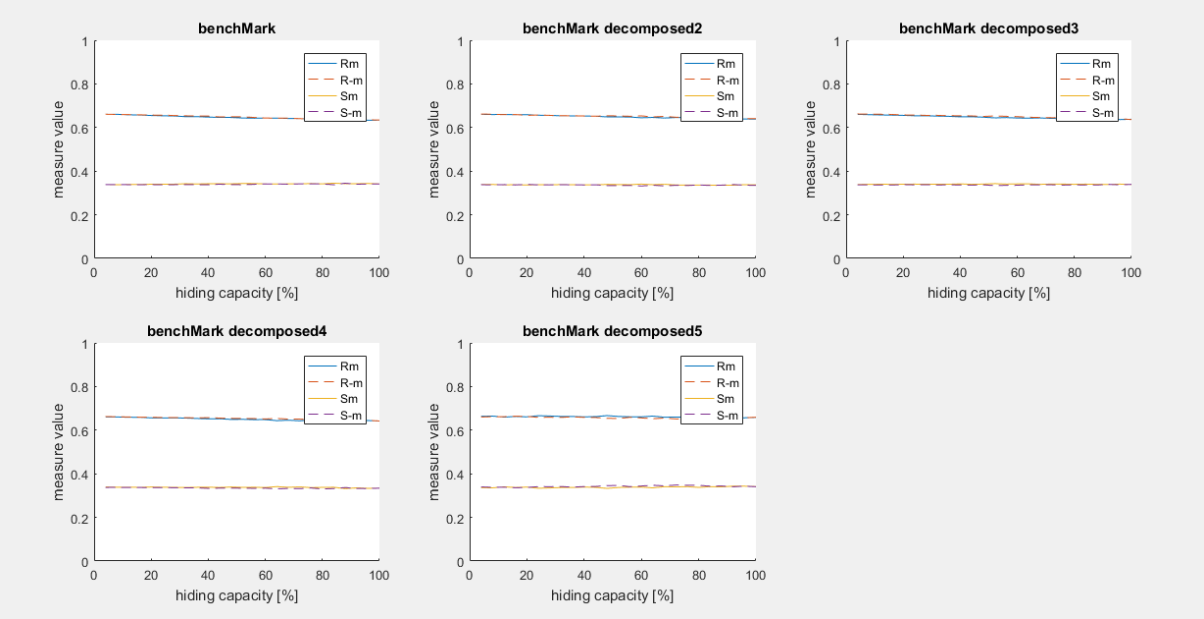


We notice that decomposed approaches have lower SSE, thus they are more secure

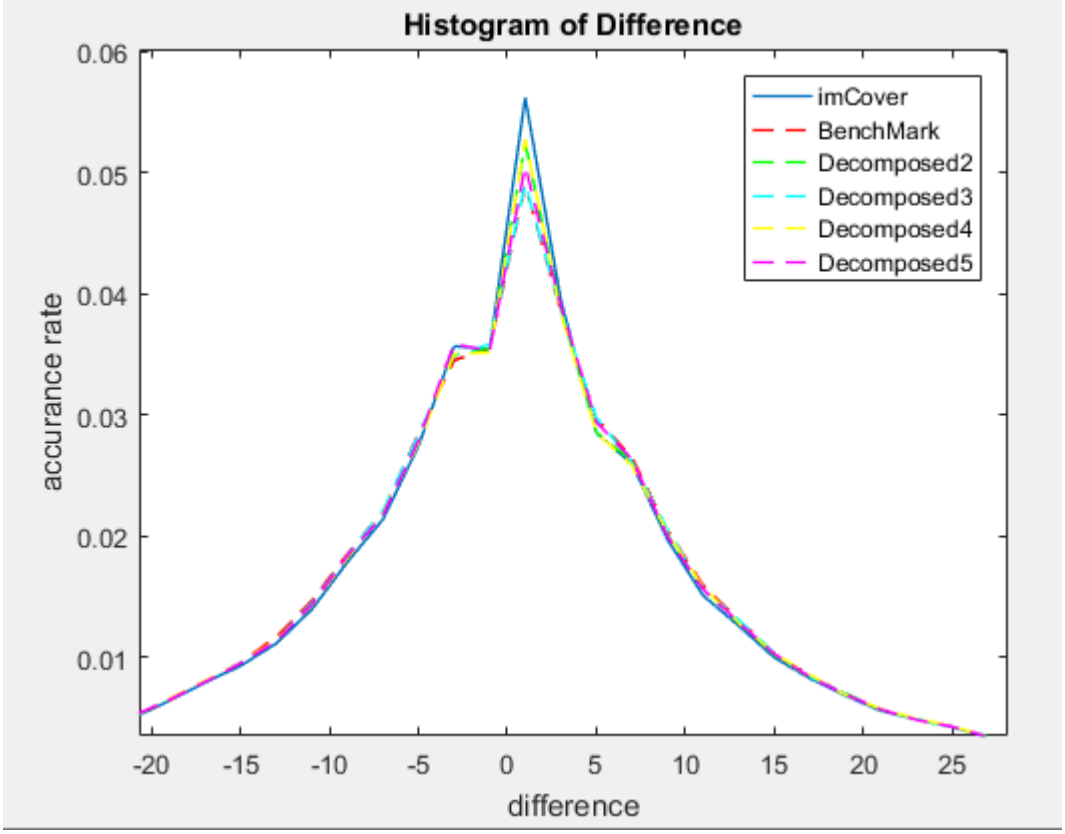


we notice that the MSE gets smaller as n (decomposition degree) gets higher

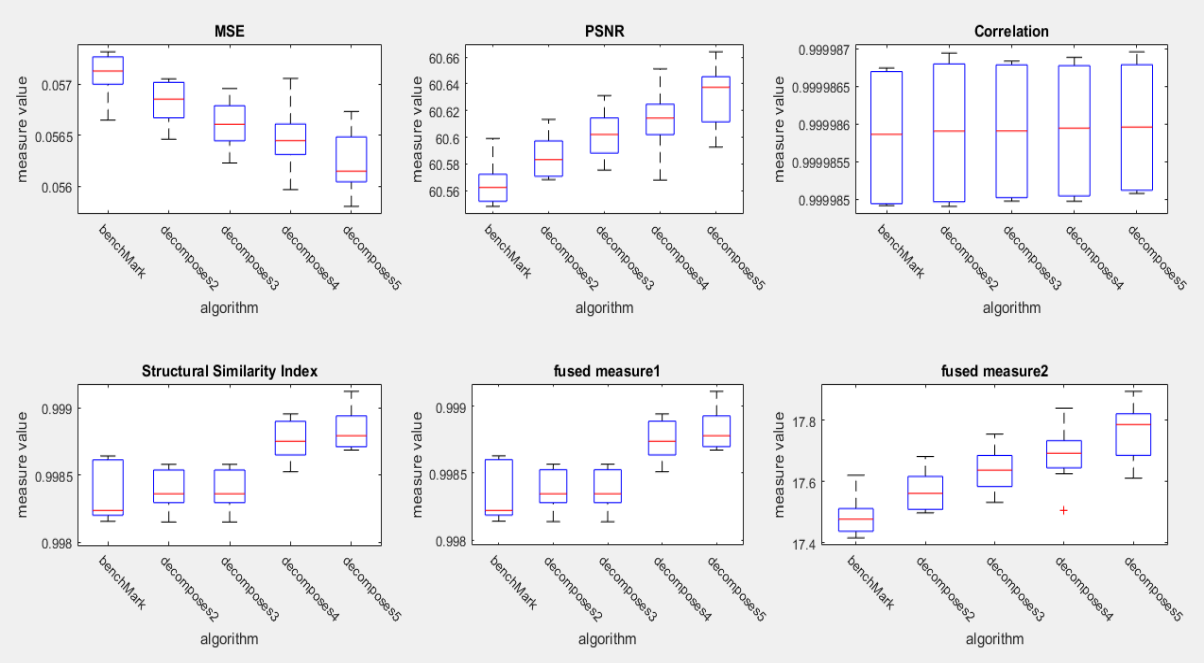
RS analysis

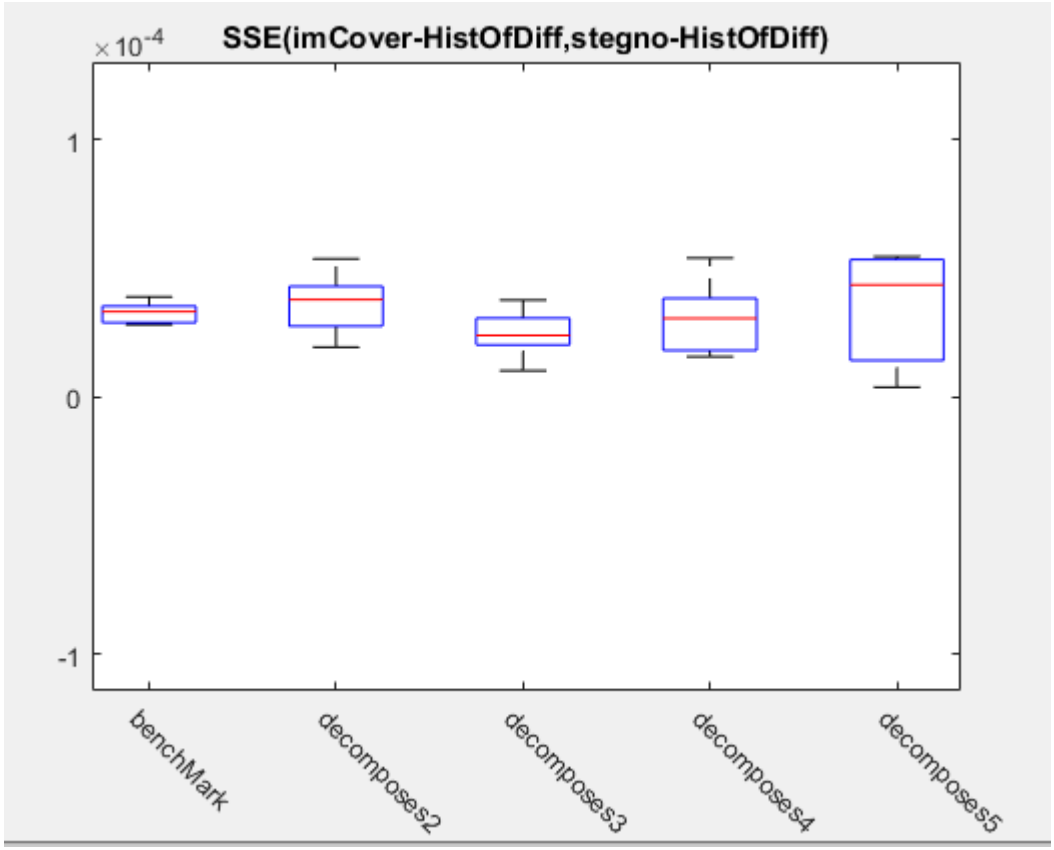


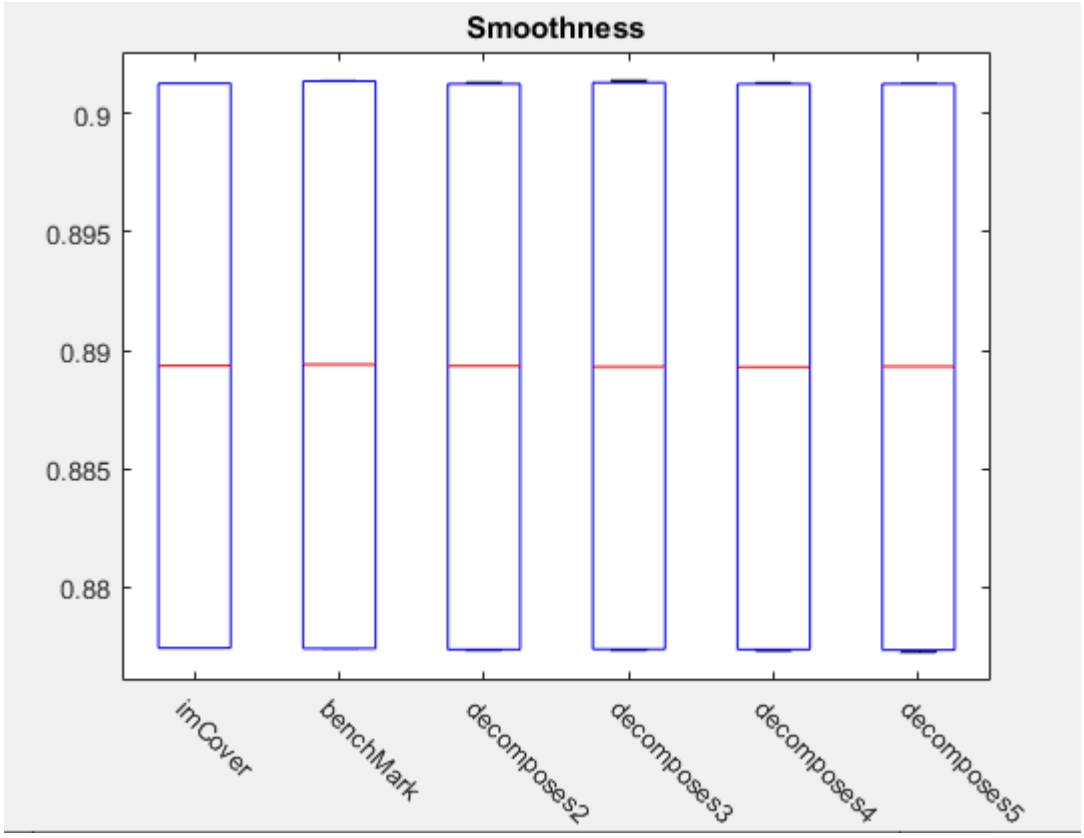
We notice that all algorithms are secure

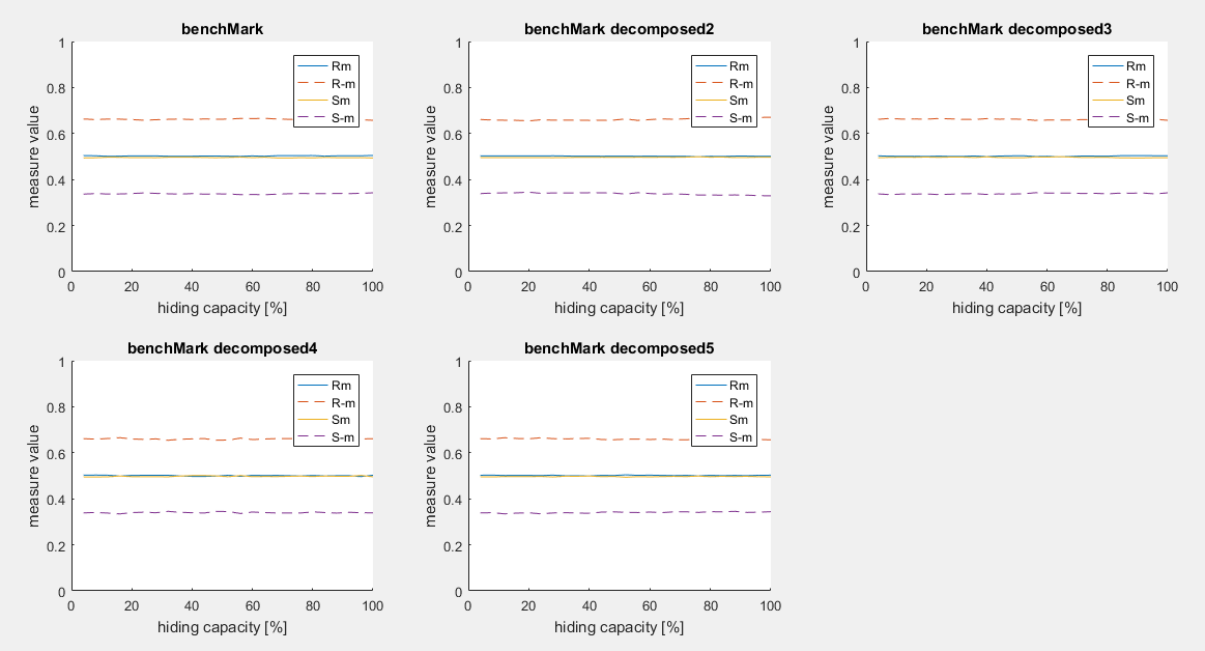


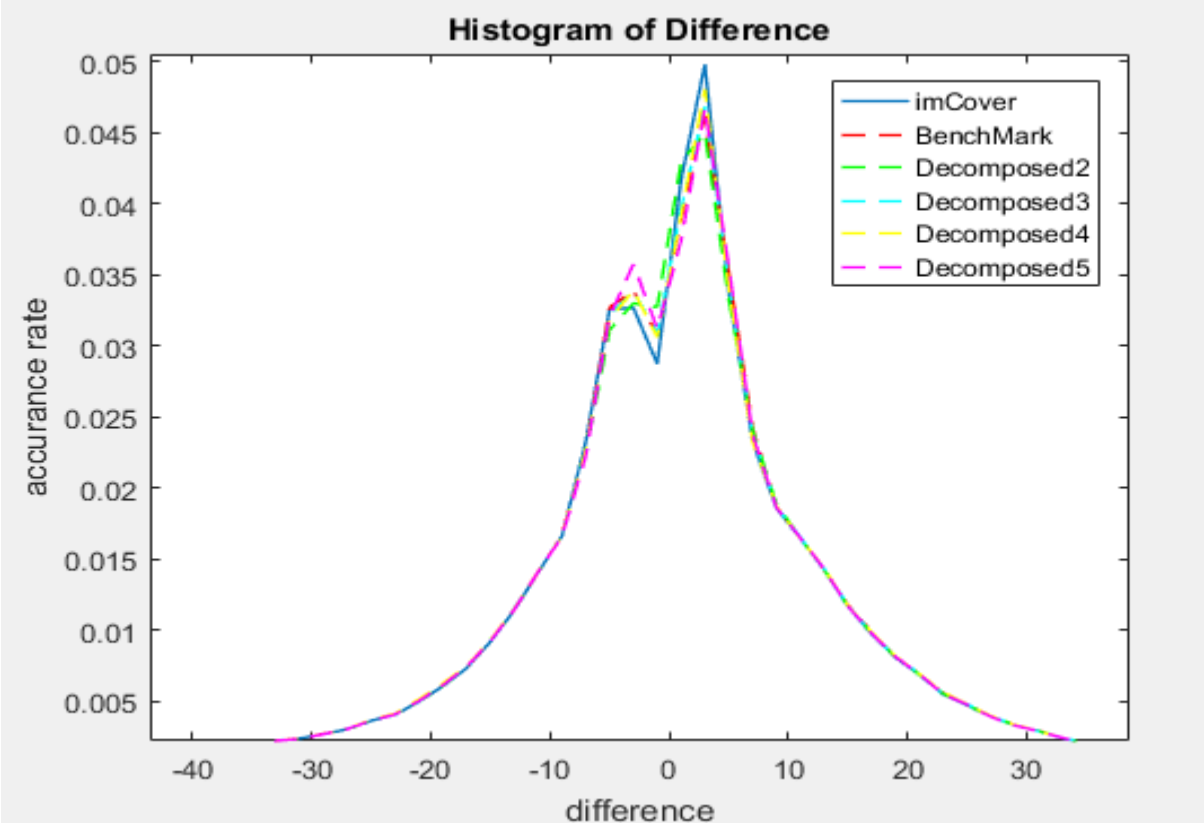
2-Rentina dataset



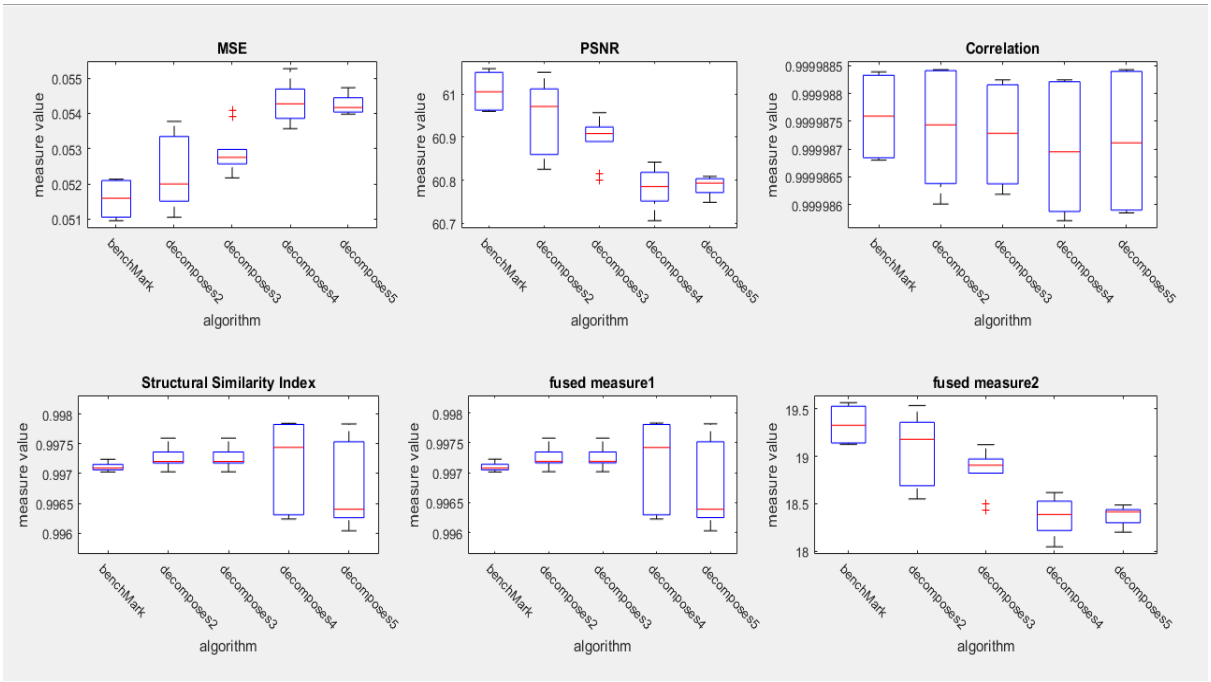

SSE(imCover-HistOfDiff,stegno-HistOfDiff)
×10^-4
1
0
-1
benchMark
decomposes2
decomposes3
decomposes4
decomposes5


Smoothness
0.9
0.895
0.89
0.885
0.88
imCover
benchMark
decomposes2
decomposes3
decomposes4
decomposes5

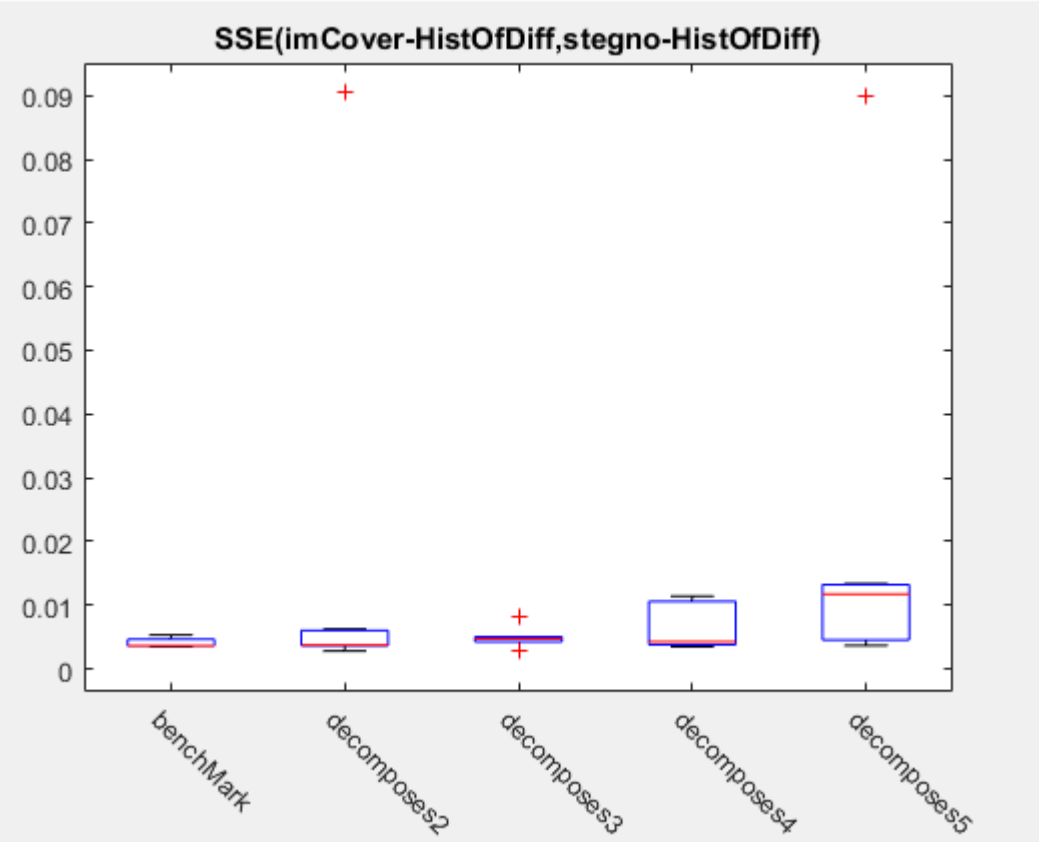

benchMark
benchMark decomposed2
benchMark decomposed3
benchMark decomposed4
benchMark decomposed5
Rm
R-m
Sm
S-m
measure value
hiding capacity [%]


Histogram of Difference
imCover
BenchMark
Decomposed2
Decomposed3
Decomposed4
Decomposed5
accurance rate
difference

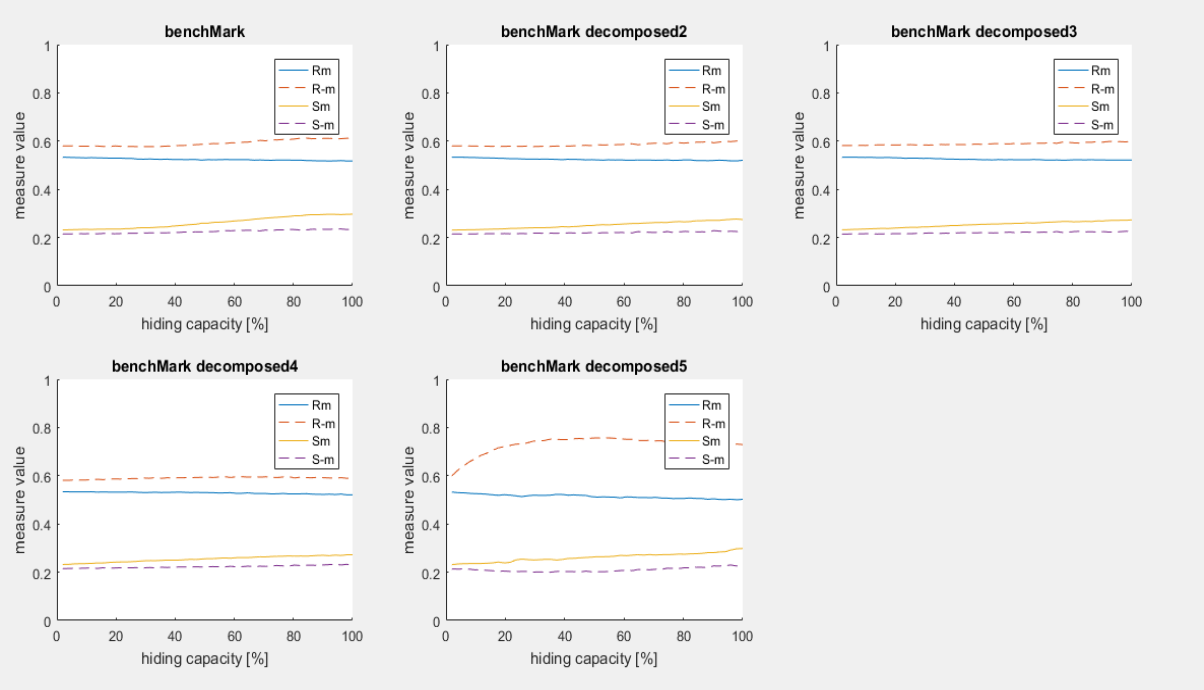
3-Brain dataset



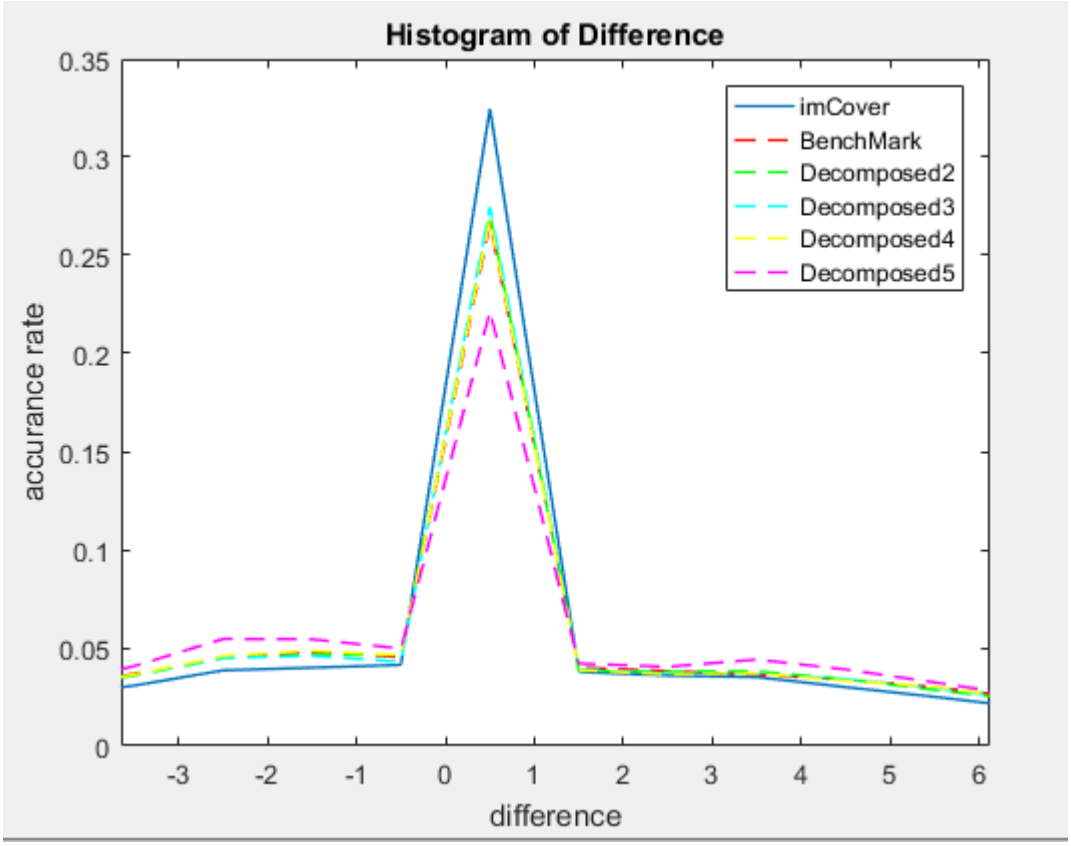
We notice that the MSE is higher in decomposed algorithms when we selected Brain dataset, and a possible reason is that brain images are more homogenius and have large black background, so the distribution of the message may damage the image by imbedding the secret bits in the background.


SSE(imCover-HistOfDiff,stegno-HistOfDiff)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
benchMark
decomposes2
decomposes3
decomposes4
decomposes5


Smoothness
0.726
0.724
0.722
0.72
0.718
0.716
0.714
0.712
0.71
imCover
benchMark
decomposes2
decomposes3
decomposes4
decomposes5



We see that all algorithms are not secure in term of RS analysis in Brain dataset



Conclusion:

- Decomposition of the message to n sub-messages gives better results in hetrogenious images, and the images that not contain a large background.
- A possibel solution for applying the decomposition algorithms in the images that have a large background is to avoid embidding the secret bits in the background that may be recognised by smoothness calculation.

Tracing Example:

In video folder