メディア情報に関する不変量理論及び著作権保護への応用

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Abstract: We show a Reeb-graph of topological invariants of images in a scale-space for contents identification. Instead of salient points, we use topologically stable blobs or primary sketches with nonzero lifetimes and areas. The continuum of such blobs as a 3D manifold is featured by a Reeb graph. This representation is robust against various deformation attacks and perturbations. A fast matching algorithm for the graphs is also presented.

Cryptography/authentication are not enough: MAC/hash do not work

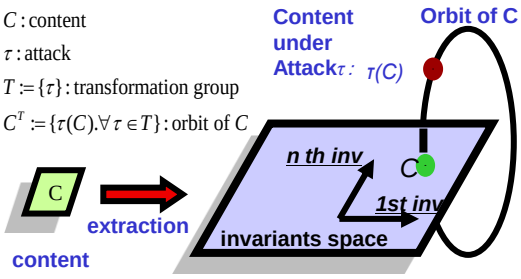
1.Difficult to detect watermarks under deformation attacks etc.
2. Deterioration of contents quality

Using inherent features of contents:

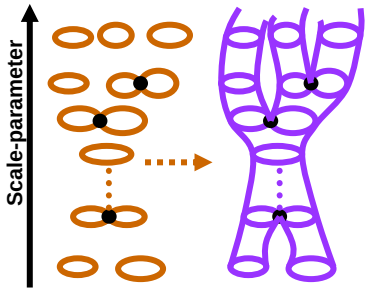
Without embedding of foreign information
Free of quality deterioration of contents.

Using topological invariants:

To defend unknown and potential attacks of any continuous deformations



Contents identification by invariants

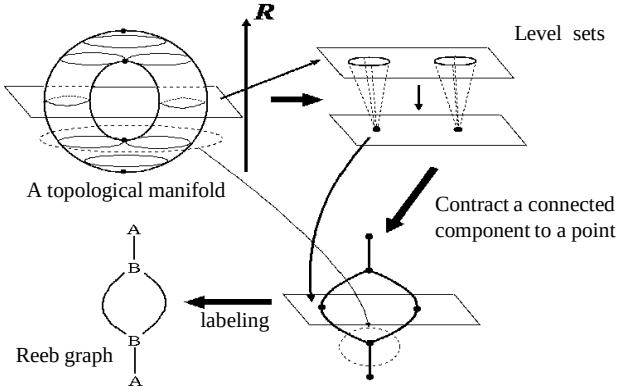


1. Chose topologically stable primal sketch as invariants. e.g. blobs with long lifetime or with large areas

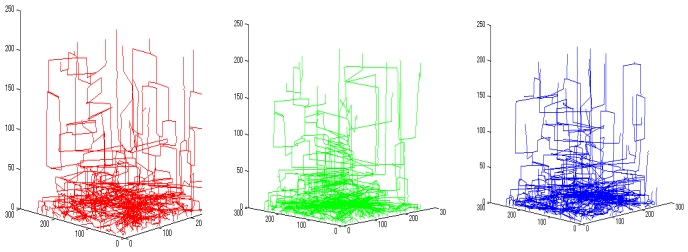
2. Regard the continuum of blobs as a 3D topological manifold, obtain a 1D higher therefore more stable object!

:level set as blob　:critical point

Morse theory in scale space: homological decomposition of manifolds



Reeb graph as a tree of topological invariants



Reeb graph of R-G-B in “Girl”

Arial	Baboon	Balloon	Car	Couple
-0.4036	-0.5721	-0.4796	-0.3451	-0.4597
-Earth	-F16	-Lena	-Lady	-Woman
-0.2079	-0.3757	-0.7134	-0.4958	-0.5509
-House	-Jelly beans	-Milk drop	-Parrots	-Pepper
-0.4905	-0.2612	-0.4210	-0.4454	-0.5185
-Sail boat	-Tiffany	-Tree		
-0.3674	-0.6266	-0.3842		

Similarity between “Girl” and test images

Origin	Jpg10	Jpg15	Jpg25	Jpg40
1.00	0.94	0.94	0.95	0.95
Jpg60	Jpg80	Jpg100	AFF1	AFF2
-0.96	-0.98	-0.98	-0.93	-0.89
AFF3	-AFF4	PROJ1	PROJ2	PROJ3
-0.94	-0.90	0.96	0.92	-0.88
PROJ4	ROT30°	ROT45°	ROT90°	NGT1
0.87	0.93	0.92	0.99	0.89

Similarity between “girl” and its deformed copies