



Use of Image Processing Techniques in the Diagnosis of Brain Tumor

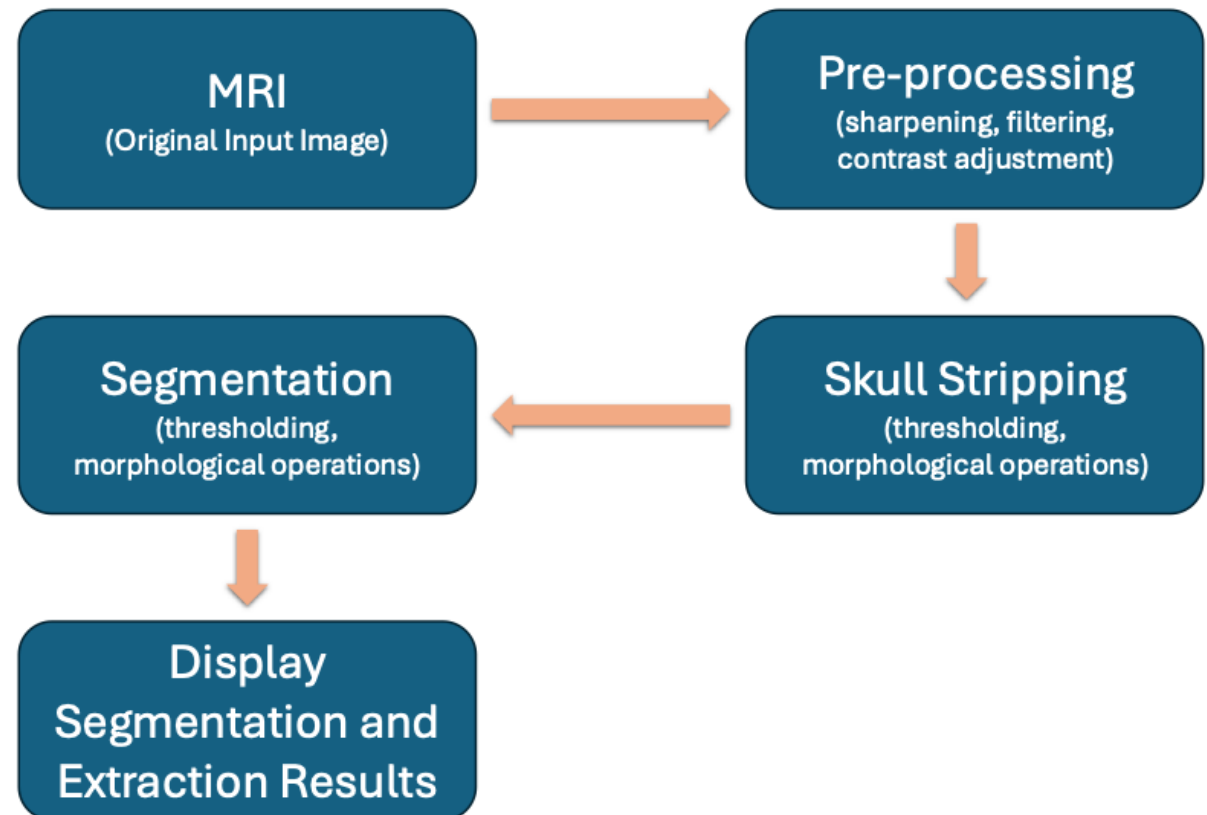
Esame di Image Processing

de Gioia Domenico



«Identification of Brain Tumor and
Extracting its' Features through
Processing of MRI»
(10.1109/ICITR51448.2020.9310800)

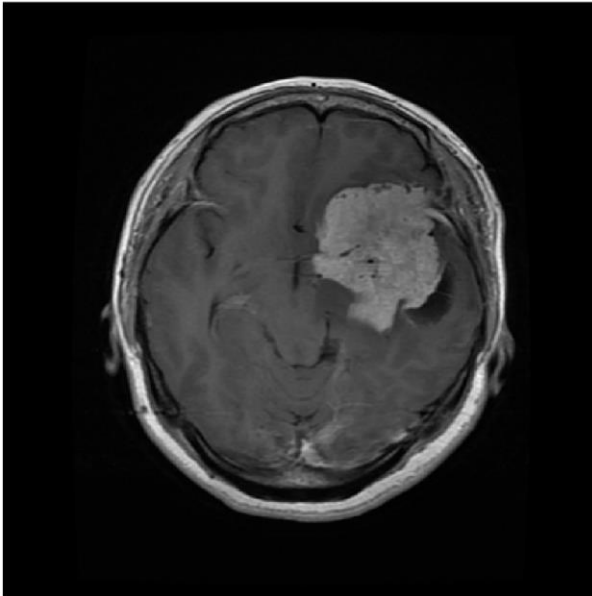
Metodologia generale



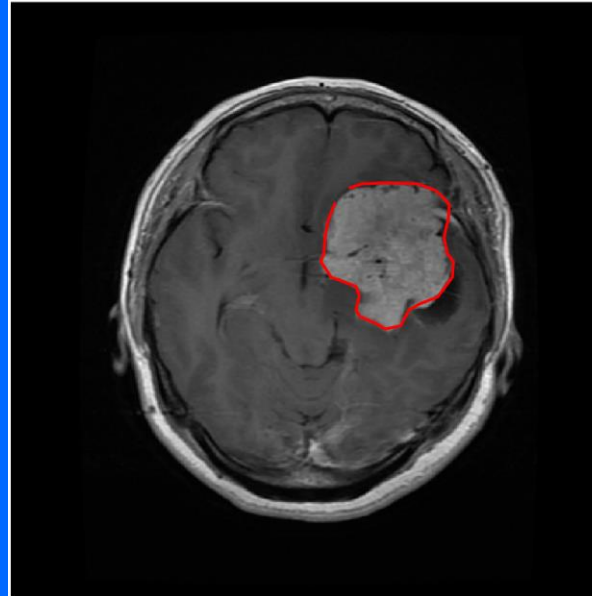
Dataset

- 3064 immagini MRI T1-contrast-enhanced
- Classi di tumori presenti: meningioma, glioma, pituitario
- Risoluzione: 512x512 pixel
- Label delineate da radiologi

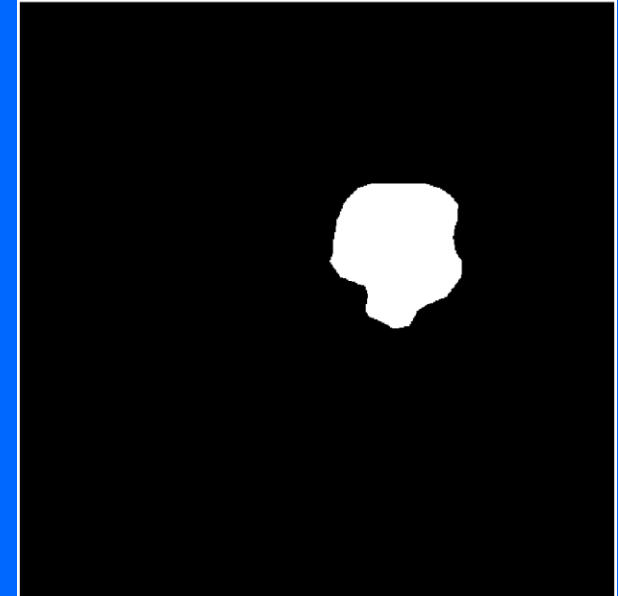
Tumor Image



Tumor Border



Tumor Mask



Pre-processing

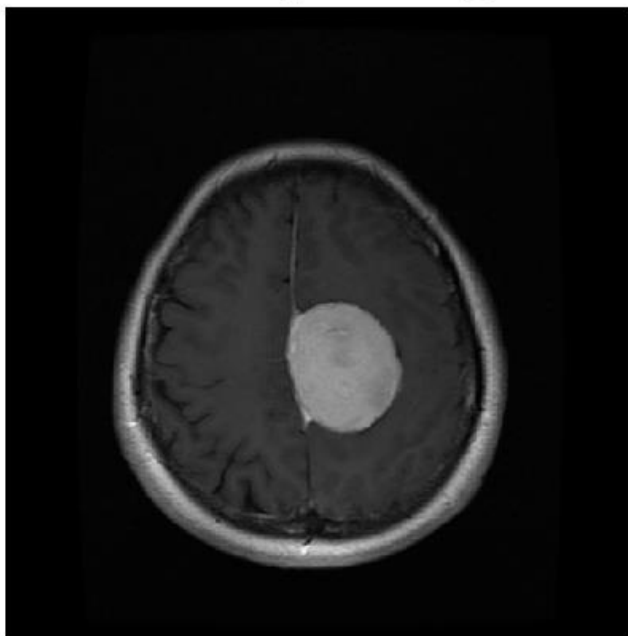
Sharpening

Filtro
mediano

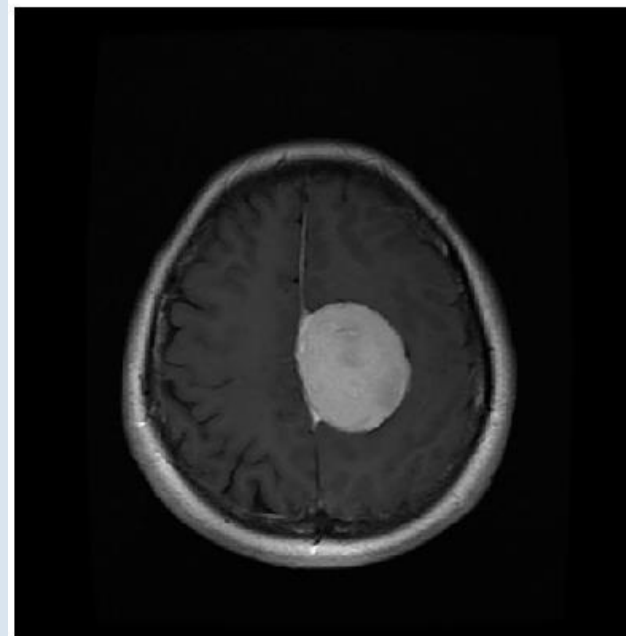
Filtro
gaussiano

Regolazione
del
contrasto

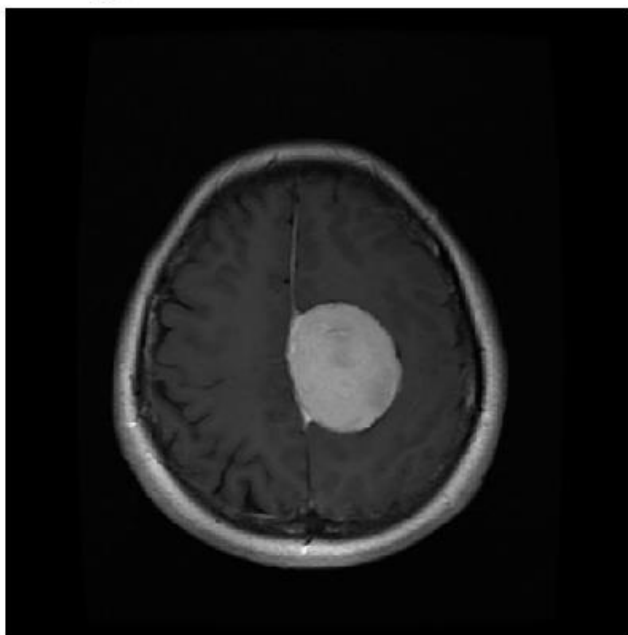
sharpening



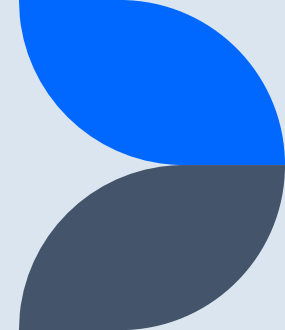
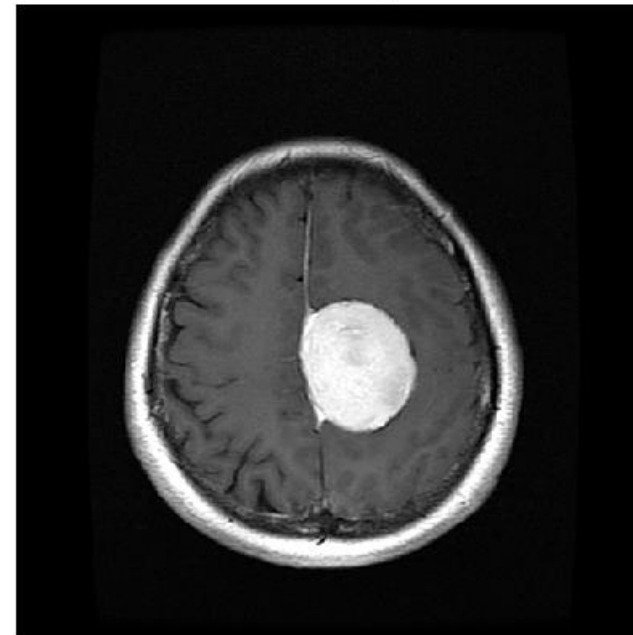
median filter



gaussian filter



contrast adjustment



Skull-stripping

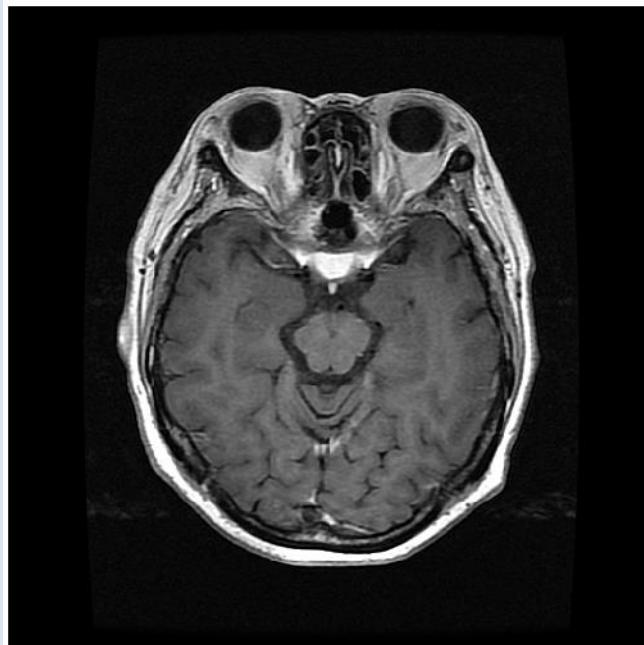
Thresholding

Rimozione
oggetti
piccoli

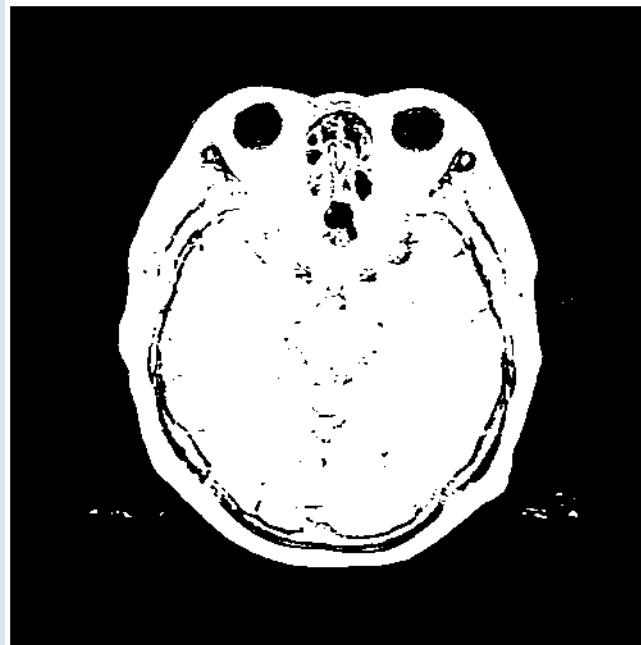
Riempimento
buchi

Erosione

skull



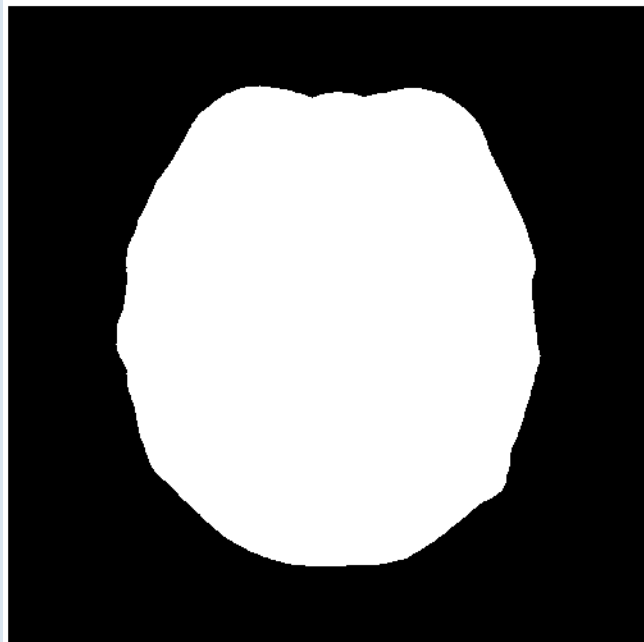
thresholding



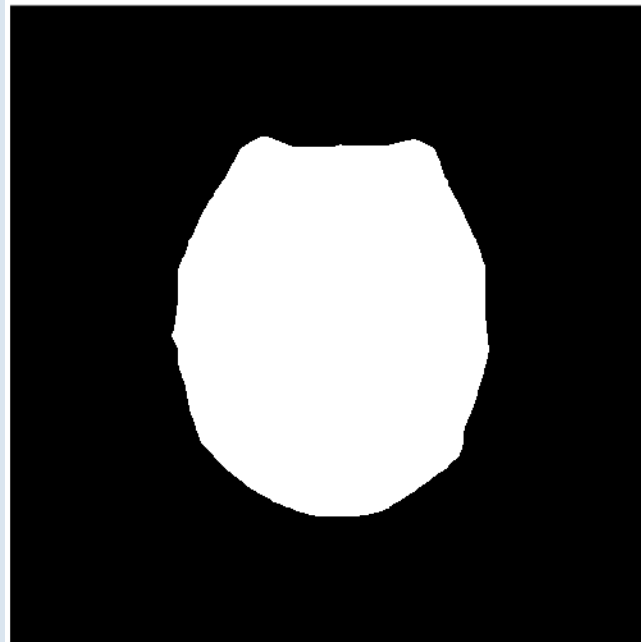
remove small objects



filling holes



erosion



brain



Segmentazione del tumore

Thresholding

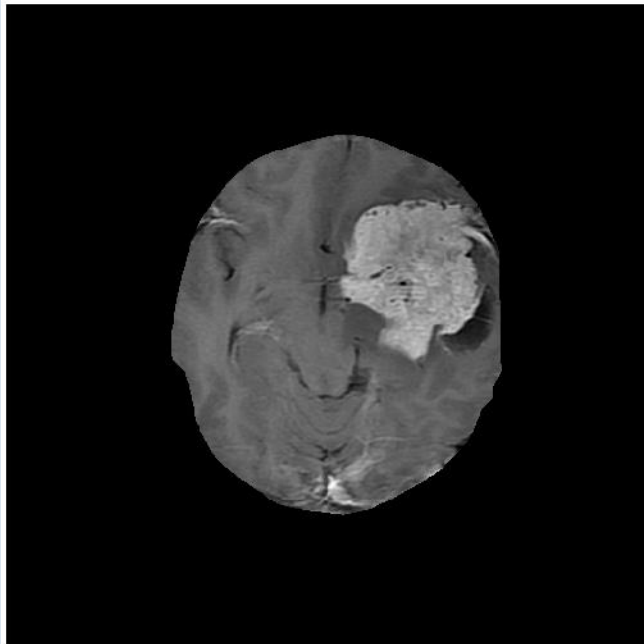
Erosione

Componente
principale

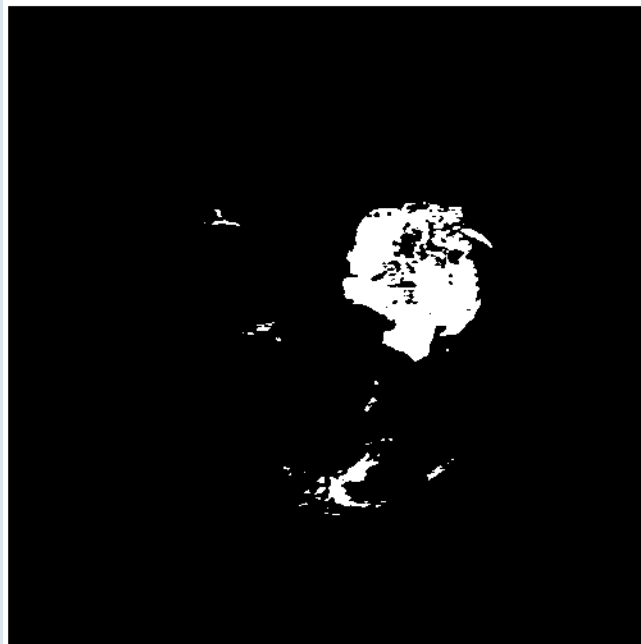
Dilatazione

Riempimento
buchi

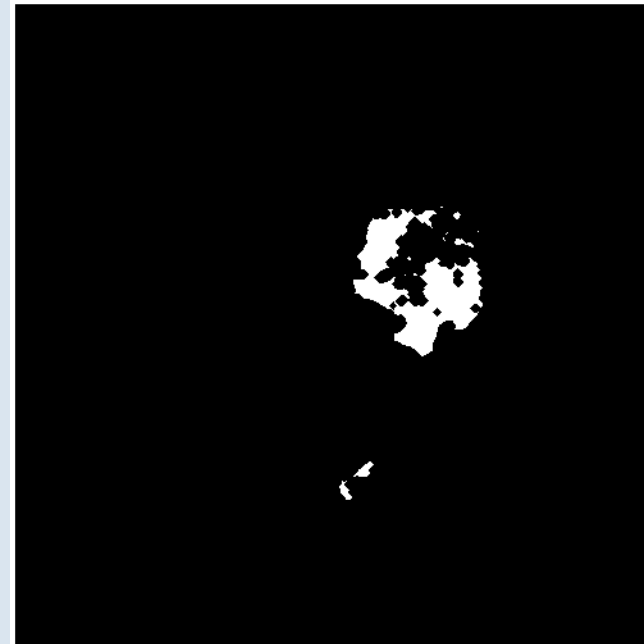
brain



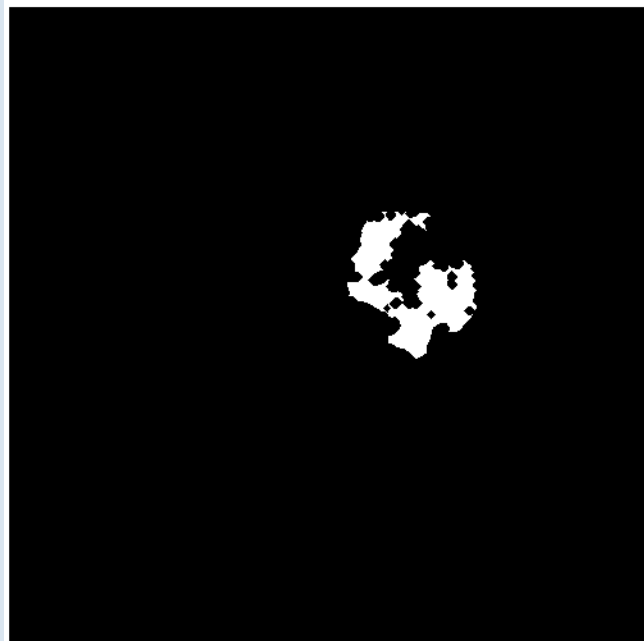
thresholding



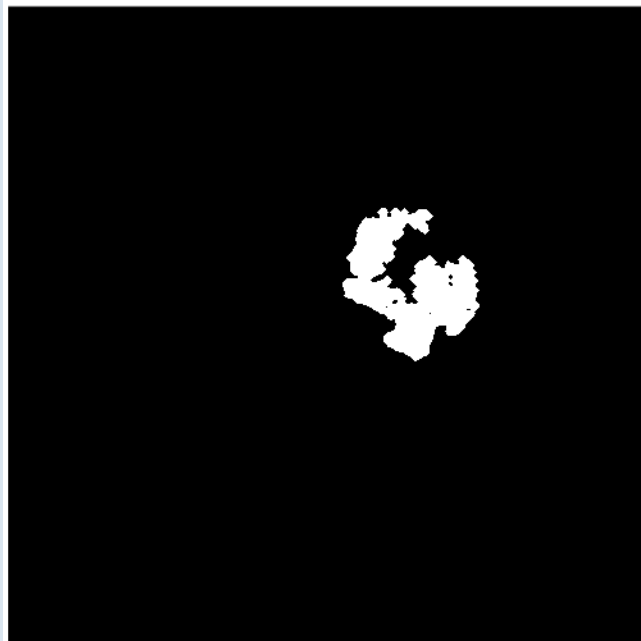
erosion



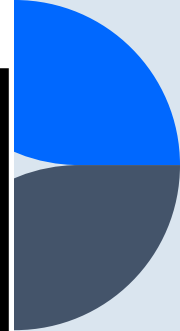
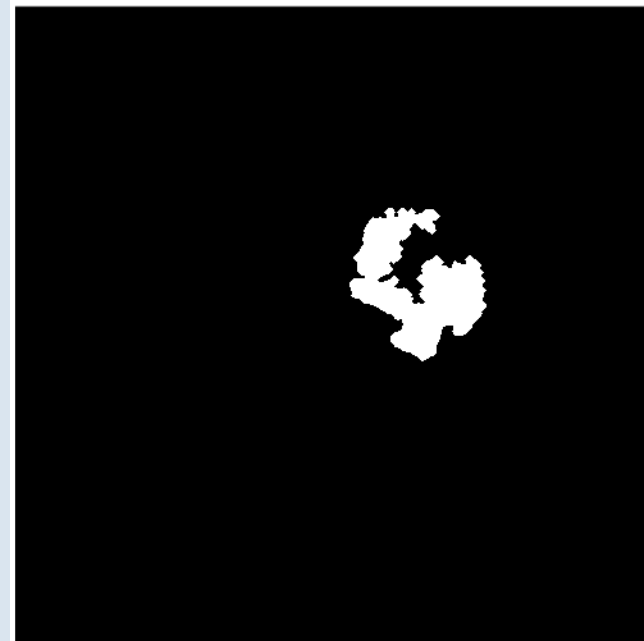
bwconncomp



dilation



filling holes



$$\text{Contrast} = \sum_{i=0}^{N-1} \sum_{j=0}^{N-1} (i-j)^2 P(i, j)$$

$$\text{Correlation} = \frac{\sum_{i=0}^{N-1} \sum_{j=0}^{N-1} (i - \mu_i)(j - \mu_j) P(i, j)}{\sigma_i \sigma_j}$$

$$\text{Homogeneity} = \sum_{i=0}^{N-1} \sum_{j=0}^{N-1} \frac{P(i, j)}{1 + |i - j|}$$

$$\text{Entropy} = - \sum_{i=0}^{N-1} \sum_{j=0}^{N-1} P(i, j) \log(P(i, j))$$

$$\text{Energy} = \sum_{i=0}^{N-1} \sum_{j=0}^{N-1} P(i, j)^2$$

Estrazione delle feature



Img	Jaccard	Dice	BFScore	Acceptable
1	0.7886	0.8818	0.8260	Yes
2	0.5619	0.7195	0.5615	Yes
3	0.6195	0.7650	0.5361	Yes
4	0.7572	0.8618	0.6095	Yes
5	0.3454	0.5134	0.1791	Yes
6	0.7266	0.8416	0.8004	Yes
7	0.0000	0.0000	0.0000	No
8	0.6800	0.8095	0.7793	Yes
9	0.0650	0.1220	0.0000	-
10	0.8932	0.9435	0.9845	Yes
11	0.9242	0.9606	0.9903	Yes
12	0.9462	0.9723	0.9844	Yes
13	0.9542	0.9765	0.9916	Yes
14	0.9355	0.9666	1.0000	Yes
15	0.9016	0.9482	0.9723	Yes
16	0.0000	0.0000	0.0000	No
17	0.6802	0.8097	0.7019	Yes
18	0.8602	0.9248	0.9712	Yes
19	0.5430	0.7038	0.6974	Yes
20	0.6126	0.7598	0.4462	Yes
21	0.8047	0.8918	0.7617	Yes
22	0.9025	0.9487	0.9123	Yes
23	0.9268	0.9620	1.0000	Yes
24	0.7231	0.8393	0.7198	Yes
25	0.6040	0.7531	0.6449	Yes

Table 1. Valori di confronto delle metriche tramite metodo di sogliatura fissa.

Img	Jaccard	Dice	BFScore	Acceptable
1	0.0000	0.0000	0.0092	No
2	0.5811	0.7351	0.6016	Yes
3	0.8455	0.9162	0.7117	Yes
4	0.7788	0.8756	0.6224	Yes
5	0.3253	0.4909	0.1189	Yes
6	0.0916	0.1679	0.2515	No
7	0.0000	0.0000	0.0000	No
8	0.6659	0.7994	0.7728	Yes
9	0.0976	0.1779	0.0000	No
10	0.8025	0.8904	0.7937	Yes
11	0.9181	0.9573	0.9782	Yes
12	0.9429	0.9706	0.9894	Yes
13	0.9430	0.9707	0.9932	Yes
14	0.9250	0.9610	1.0000	Yes
15	0.8637	0.9268	0.9320	Yes
16	0.0000	0.0000	0.0000	No
17	0.6669	0.8001	0.6936	Yes
18	0.8016	0.8899	0.9163	Yes
19	0.0246	0.0480	0.0816	No
20	0.0825	0.1525	0.0000	No
21	0.1010	0.1835	0.0000	No
22	0.1129	0.2029	0.0000	No
23	0.0988	0.1799	0.0000	No
24	0.7340	0.8466	0.7199	Yes
25	0.6062	0.7548	0.6470	Yes

Table 2. Valori di confronto delle metriche tramite metodo di sogliatura Otsu.

Conclusioni e sviluppi futuri

- Buona accuratezza nella rilevazione dei tumori cerebrali
- Strumento di supporto alle decisioni mediche
- Espansione del dataset di test
- Classificazione delle lesioni cerebrali
- Integrazione di deep learning per segmentazione avanzata

