Fully Automated Multi-Modal Anatomic Atlas Generation Using 3D-Slicer

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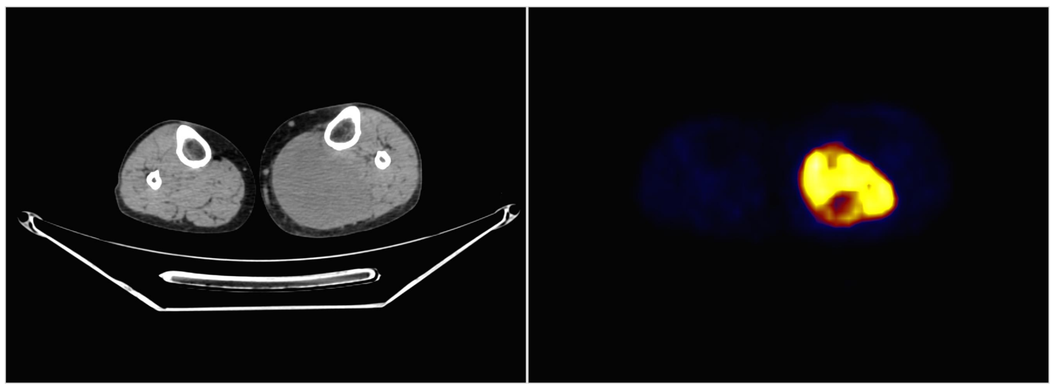
Background

- Atlases usually based on imaging modalities like CT and MRI
- Excellent image quality and resolution, but anatomical information only
- Functional imaging poor in resolution, no anatomical information
- Combined scanners (e.g. PET/MR) locate both in the same reference frame
- Atlases of functional information based on the registered anatomical data



We present an easy to use framework that allows for the effortless computation of combined anatomical and functional atlas volumes and integrates text-based patient information into an automatically generated database.

3D Slicer module

Database creation

- Database creation from text file
- Automatically chooses parameters and schema

Registration pipeline

- Pre-aligned data (e.g. PET/MR)
- Pairwise affine registration to reference
- FFD B-Spline registration to reference
- Multi-resolution optimization scheme

Atlas computation

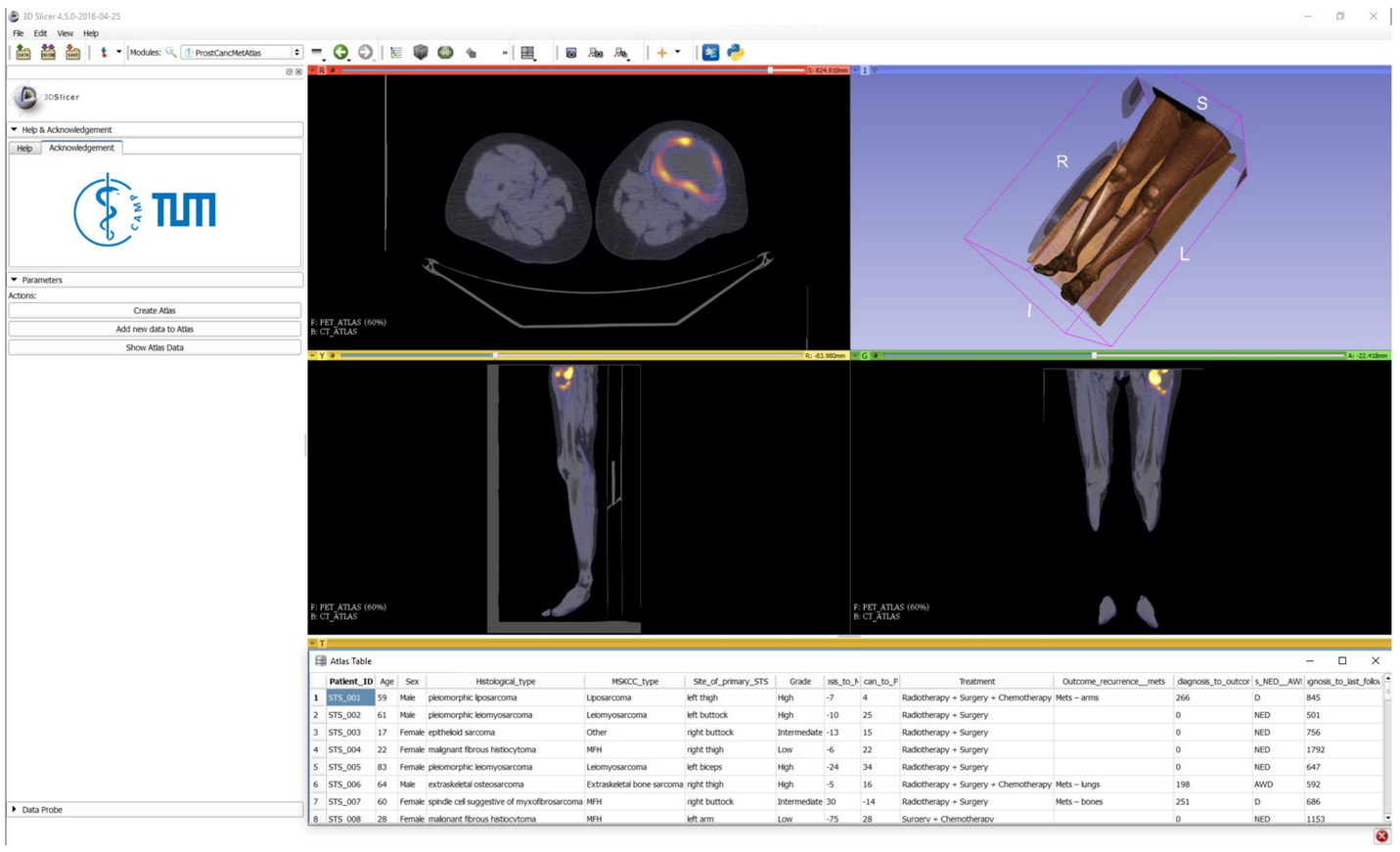
- Apply transformation to anatomical and corresponding functional data
- Average across all samples
- Visualize images and database

Results

- Publicly available sarcoma dataset
- 24 FDG-PET/CT volumes
- Functional data SUV normalized
- Maximum iterations 50 and 20
- Sampling ratio 0.075
- 4 level multi-resolution
- Mean SUV 30 times higher inside ROI

Site of primary STS	count
left thigh	10
right thigh	4
right calf	3
right quadricep	2
left poplietal fossa	1
left calf	1
right buttock	1
left adductur	1
right knee	1

$$SUV = c \cdot \frac{1000 \cdot w}{d \cdot e^{\frac{-0.693 \cdot t}{t_{0.5}}}}$$



Patient_ID	Age	Sex	Histological_type	MSKCC_type	Site_of_primary_STS	Grade	Treatment	Outcome_recurrence__mets	diagnosis_to_outcor	s_NED__AWI	gnosis_to_last_follo
1 STS_001	59	Male	pleiomorphic liposarcoma	Liposarcoma	left thigh	High	Radiotherapy + Surgery + Chemotherapy	Mets – arms	266	D	845
2 STS_002	61	Male	pleiomorphic leiomyosarcoma	Leiomyosarcoma	left buttock	High	Radiotherapy + Surgery		0	NED	501
3 STS_003	17	Female	epithelioid sarcoma	Other	right buttock	Intermediate	Radiotherapy + Surgery		0	NED	756
4 STS_004	22	Female	malignant fibrous histiocytoma	MFH	right thigh	Low	Radiotherapy + Surgery		0	NED	1792
5 STS_005	83	Female	pleiomorphic leiomyosarcoma	Leiomyosarcoma	left biceps	High	Radiotherapy + Surgery		0	NED	647
6 STS_006	64	Male	extraskeletal osteosarcoma	Extraskeletal bone sarcoma	right thigh	High	Radiotherapy + Surgery + Chemotherapy	Mets – lungs	198	AWD	592
7 STS_007	60	Female	spindle cell suggestive of myxofibrosarcoma	MFH	right buttock	Intermediate	30 -14	Radiotherapy + Surgery	Mets – bones	251	D	686
8 STS_008	28	Female	malignant fibrous histiocytoma	MFH	left arm	Low	-75 28	Surgery + Chemotherapy		0	NED	1153

Conclusion

- Demonstration of fully automated 3D Slicer module to generate multi-modal atlas and integrated database
- Method applicable for many different applications (anatomical/functional data, anatomical data/segmentation,…)
- Fast and simple interlinkage of imaging data with knowledge from database
- Further processing with 3D Slicer

References

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