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LIFEx: a user-friendly software to support reproducible radiomic and AI studies in multimodal imaging

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Download the software

Purpose

Radiomics and AI-assisted medical image analysis are growing areas of great interest. Many development frameworks are available for conducting radiomic and AI-based image analysis, yet most of them require some programming knowledge. In 2017, the LIFEx software was introduced as a user-friendly platform to support medical image display, basic image processing and automated calculation of radiomic features without requiring any coding skills.

Here, we present some of the many new functionalities that have been included in LIFEx over the past five years to make it an up-to-date and practical tool for efficiently performing radiomic and AI studies.

What is LIFEx? Local Image Feature Extraction [1]

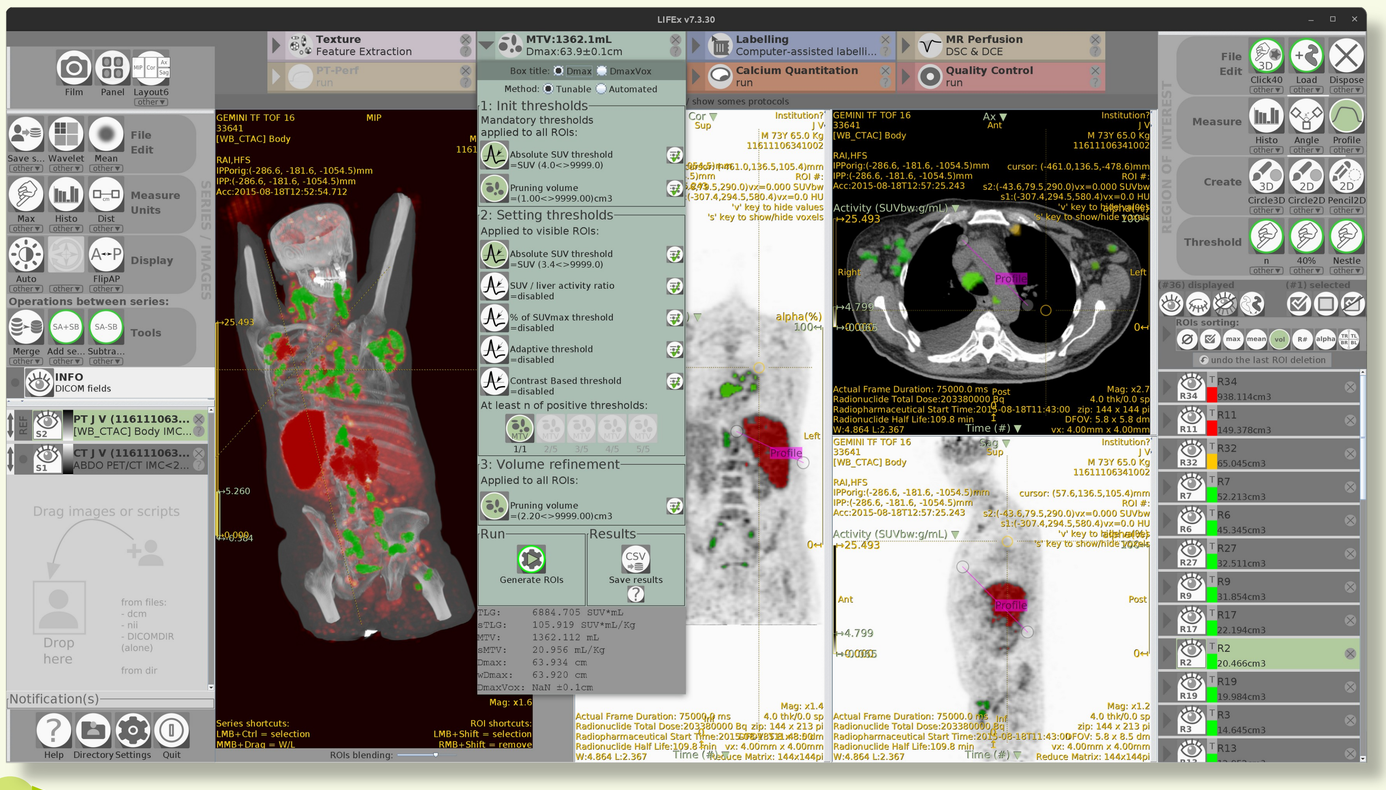
LIFEx is a free software for automatic measurement of a large number of features characterizing tissue properties from medi-cal images.

LIFEx has been especially designed for radiologists, nuclear medicine physicians, oncologists, and scientists involved in *in vivo* medical imaging (no programming skills required).

LIFEx software is available from www.lifexsoft.org

1 LIFEx: a freeware for radiomic feature calculation in multimodality imaging to accelerate advances in the characterization of tumor heterogeneity. C Nioche, F Orlhac, S Boughdad, S Reuzé, J Goya-Outi, C Robert, C Pellot-Barakat, M Soussan, F Frouin, and I Buvat. Cancer Research 2018; 78(16):4786-4789

User-friendly GUI



LIFEx graphical user interface in which a sample of protocols can be seen on the top (Radiomic feature extraction protocol, Metabolic Tumor Volume – MTV protocol, Labelling protocol, Calcium quantification protocol, etc). VOIs automatically segmented using the MTV protocol are shown in color. The display includes a Maximum Intensity Projection view (left) as well as the axial, coronal and sagittal slices.

New biomarkers

Recently introduced biomarkers, such as the normalized distance from hotspot to centroid (2) reflecting tumor aggressiveness, are now available in LIFEx.

Total Metabolic Tumor Volume from PET/CT images can be easily calculated using a dedicated protocol, including a practical one-click interactive tool to add or remove any high-uptake region from the Maximum Intensity Projection views. When multiple lesions are present, various disease dissemination biomarkers can be automatically calculated.

2 Evolutionary dynamics at the tumor edge reveal metabolic imaging biomarkers. Juan Jiménez-Sánchez et al. PNAS 2021

Scripts

LIFEx can be used interactively, or operations can be scripted for repeated processing of many image series.

All settings and results can be saved for traceability. Radiomic features extracted with the software can be easily analyzed using user-friendly statistical and machine learning software such as Orange: orangedatamining.com

Strategy

Development strategy

LIFEx evolutions have been driven by:

The need to comply with the Image Biomarker Standardisation Initiative (IBSI) guidelines (3) by providing access to 306 histogram, textural and shape indices. The correct implementation of radiomic feature calculation has been thoroughly checked using IBSI benchmarks. Novel experimental and validated radiomic features have been implemented.

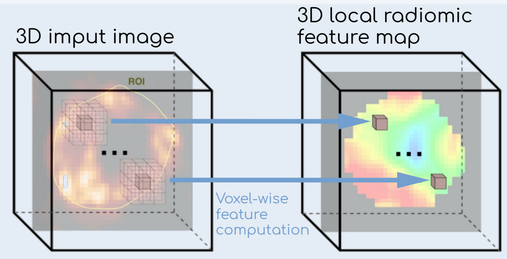
A careful follow-up of advances in the field / fruitful interactions with LIFEx users. New needs in terms of image annotation for supervised learning: a practical annotation module has been developed (see New Labeling Tool).

3 Image Biomarker Standardisation Initiative. Zwanenburg A et al. Radiology 2020

New Radiomic maps

Feature maps are computed using a 3×3×3 voxels kernel and the result is assigned to the central voxel of this window in the resulting 3D feature map (4).

This process is repeated for all features and all voxels inside the ROI.



4 Voxel-wise supervised analysis of tumors with multimodal engineered features to highlight interpretable biological patterns. T Escobar, P Pineau, S Vauclin, F Orlhac, C Nioche, L Champion, H Brisse, I Buvat. Med Phys 2022

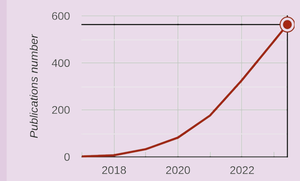
Awards

2018 — The Best of THE AACR JOURNALS — A COLLECTION OF THE MOST-CITED RESEARCH ARTICLES [1]

2020 — Prix unicancer de l'innovation 6e édition

Analytics

2016 - 2023 Newly created website user accounts for downloads



2016 - 2023 Publications referencing LIFEx

New Labeling Tool

A module (see New Labeling Tool) is proposed to quickly annotate images using pre-defined or customized menus for subsequent supervised machine learning.

Controller:
The controller panel shows the progress of the annotation job, which can be interrupted at any time and resume exactly where it was left off.

Patient selector:
The patient selection panel allows the user to specify a list of patients whose images are then automatically loaded as annotation tasks are completed.

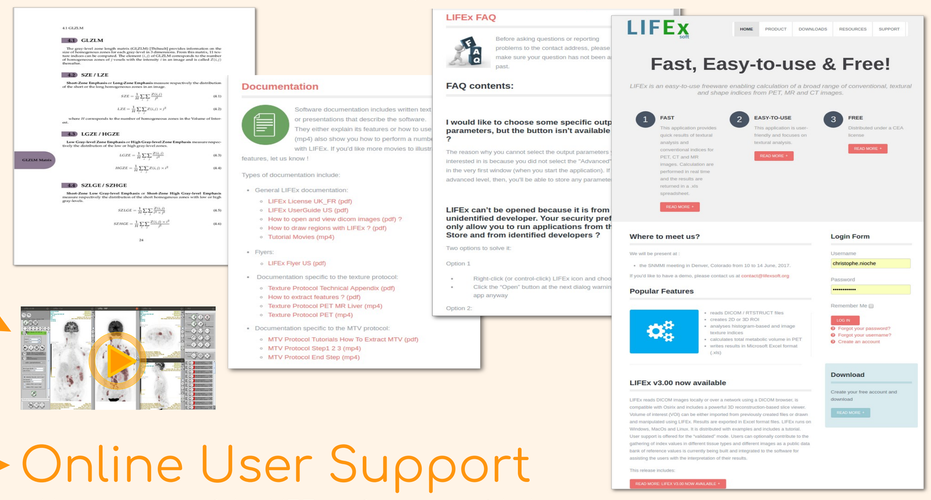
LabelingScript.txt

```
# Common
script = labeling
script.version = 1.0
output.props.file=.../res/labeling.props

# properties
property0.title = Organ*
property0.type = dropdown
property0.value = 1|2|3|4

property1.title = Comment
property1.type = textfield

property2.title = ROI
property2.type = roiPick

property3.title = Nodule*
property3.type = radiobutton
property3.value = Yes|No

property4.title = Tumor grade*
property4.type = checkbox
property4.value = I|II|III|IV

property5.title = Voxel pick
property5.type = voxelPick
```

Property input panel:
The properties panel can be easily customized to include menu, free-text boxes, or multiple choices for interactive annotation.

User's Support

Documentation, FAQ, Movie tutorial



Online User Support

User support of the LIFEx software provided at contact@lifexsoft.org and www.lifexsoft.org

Conclusion

LIFEx has been downloaded by over 7,500 users around the world and is cited in more than 500 publications.

LIFEx is a modular and upgradeable tool that evolves to meet the users' needs. Being free and compatible with any operating system, it is widely adopted to conduct radiomic studies in a non-coding environment.

By allowing researchers to reproduce previously published radiomic results, LIFEx is helping to significantly advance radiomics and AI studies.