

# LIFEx v6.00

## Announcement

— LIFEx —

C. Nioche, I. Buvat



# What is new?



LIFEx version 6.00

Last update of document: 2020/04/30



# LIFEx v6.00

Annoucement  
— LIFEx —

# Acknowledgements

Dear LIFEx users,

We are pleased to announce the release of **LIFEx v6.00**. Do not hesitate to download this new release and replace your old LIFEx version.

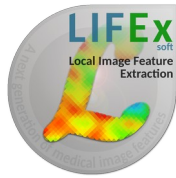
We would like to take this opportunity **to thank all 3.000 LIFEx users** for their feedback and relevant suggestions. We took into account your comments to enhance the software and produce this version. We hope you will enjoy it.

Your feedback will always be welcome.

LIFEx is free of charge. **Please help us to keep it free by always quoting the LIFEx reference (see below):**

Please note that the correct reference to be cited is:

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



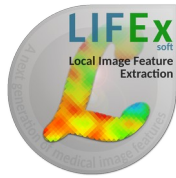
# LIFEx v6.00

Annoucement  
— LIFEx —

# Interface screenshot

The screenshot displays the LIFEx v6.00 software interface, which is a comprehensive tool for PET/CT image analysis. The interface is organized into several key sections:

- Top Panel:** Contains various processing and analysis modules such as "Texture Feature Extraction", "MTV-35 mL SMTV-0.5 mL/Kg", "Labeling Computer-assisted", "MTV Notation Metabolic Tumor Volume", "MR Perfusion DSC & DCE", "Calcium Quantitation Controller", and "Quality Control run".
- Left Panel:** Includes a "Patient" list, "Processed Images" list, and a "PT M" (PET/CT) processing panel with options for "Units" (min, SUVbw) and "Dimension processing" (2D, 3D).
- Central Panel:** The main workspace showing a 3D PET/CT scan of a patient's torso. A region of interest (ROI) is highlighted in red, and a cursor is positioned over it. The interface shows various views (axial, sagittal, coronal) and a color scale for activity (SUVbw/g/mL).
- Right Panel:** Features a "Graphs" section with a plot of "Relative concentration of gadolinium" vs "Time (min)". The plot shows a peak at approximately 29.2 seconds. Key parameters are displayed: Time to Peak (TTP)=29.2 sec (9.4 sec from ITAB), relative concentration  $y = (L/TE) \cdot \text{Mag}(\text{signal}(t)/\text{base})$ ,  $rCBV = 0.13 \text{ mL}/100\text{g}$ , and  $rCBF = 0.72 \text{ mL}/100\text{g}/\text{min}$ . Other parameters include Full Width Half Max (FWHM)=7 sec (FWHM)=0.0047 and Mean Time Transit (MTT)=35.3 sec (10.5 sec from ITAB).
- Bottom Right Panel:** Shows a "Curves" plot for "lhoik3" with "Activity (kBq/mL)" vs "Time (min)". The activity starts at approximately 45 kBq/mL and rapidly decays to a steady state of about 10 kBq/mL within 4 minutes.
- Right Side Tools:** A vertical toolbar with various icons for "Tools" (New, Load, Dispose), "Measure" (Max, Angle, Dist), "Edit" (Circle3D, Circle2D, Pen3D), "Threshold" (0, 50%, None), and "Applied to all ROI" (Hide, Show, Sort).



LIFEx v6.00

Annoucement

— LIFEx —

# CONTENTS

- Main update
- Texture update
- New Labeling protocol
- New DSC-MR protocol



# LIFEx v6.00

## Annoucement

— LIFEx —

# Main updates

C. Nioche

## Implementation of DICOM-RT Dose Module

The screenshot displays the LIFEx v6.00 software interface. At the top, there is a toolbar with icons for Patient, Panel, Film, and various analysis tools like Texture Feature Extraction, Labeling, MR Perfusion, and PT Compartmental. The main workspace is divided into four quadrants, each showing a different view of a CT scan: Coronal (top-left), Sagittal (top-right), Axial (bottom-left), and Axial (bottom-right). Each view shows a color-coded dose map overlaid on the anatomical scan. The dose scale is visible on the left of each view, ranging from 0 to 21.8 Gy/vx. The right-hand panel, titled 'ROI tools', contains a list of regions of interest (ROIs) such as ITV, CTV, BRONCHUS, RT\_LUNG, LT\_LUNG, PTV, HEART, TRACHEA, ESOPHAGUS, SPINAL\_CORD, and ITV-1st. Each ROI has a corresponding icon and volume measurement. An orange arrow points to the 'RT DOSE' button in the bottom-left corner of the interface.



# LIFEx v6.00

## Annoucement

— LIFEx —

# Main updates

C. Nioche

## Implementation of DICOM-REG (registration file between 2 series)

**DICOM REG**

Drag images or scripts

Drop here

from files: - dcm - nii - DICOMDIR (alone)

from dir

Status

Settings Directory Quit

Applied to one ROI:

Tools: New, Load, Dispose

Measure: Max, Angle, Dist

Edit: Circle3D, Circle2D, Pencil2D

Threshold: n, 40%, Nests

Applied to all ROI:

Tools: Hide, Show, Sort

Drag ROIs

Drop here

from files: - nii.gz - RTSTRUCT



# LIFEx v6.00

Annoucement  
— LIFEx —

# Main updates

C. Nioche

## Automatic removal of CT patient table

The screenshot displays the LIFEx v6.00 software interface. The main window is divided into four quadrants, each showing a different view of a CT scan: a sagittal view of the whole patient, a sagittal view of the torso, an axial view of the torso, and another axial view. The top row shows the original images with a patient table visible. The bottom row shows the same images with the patient table removed. A red arrow points from the 'CT Table' button in the left sidebar to the 'ROIs blending' section of the interface.

**Left Sidebar:**

- Buttons: Patient, Panel, Film
- Orientation: Sag, Ax, Cor, MIP
- INFO: DICOM fields
- Units: Unit X: sec, Unit Y: HU
- Buttons: Max, Resampling, Add series, FlipAP
- Buttons: Clear, Auto, CT Table
- Buttons: Reorder Layers, top layer, bottom layer
- Status: Settings, Directory, Quit

**Top Panel:**

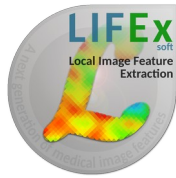
- Texture Feature Extraction
- MTV Metabolic Tumor Volume
- Labeling Computer-assisted labeling
- MR Perfusion DSC & DCE
- PT Compartmental Compartmental Analysis

**Right Panel (ROI tools):**

- Applied to one ROI: Tools (New, Load, Dispose), Measure (Max, Angle, Dist), Edit (3D, 2D, Pencil2D), Threshold (n, 40%, Neste)
- Applied to all ROI: Tools (Hide, Show, Sort)

**Bottom Right Panel:**

- Drag ROIs
- Drop here
- from files: nii, nii.gz, RTSTRUCT



# LIFEx v6.00

Annoucement

— LIFEx —

# Main updates

C. Nioche

Added / Improved / Fixed

## Added

- quick orientation (Axial, Coronal, Sagittal) is available in each frame
- display only border of ROI with border/fill button added to ROI tool menu
- implementation of 3D, 4D enhanced dicom format (Enhanced ClassStorage)
- implementation of decoder for Philips DICOM (JP2) images
- implementation of spatial resampling
- contrast-based method for ROI delination (CBM ROI tool)

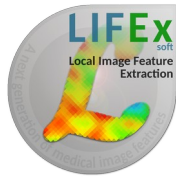
## Improved

- nifti ROI can be floating numbers (cast in integer ROI is implemented)
- list of protocols is now in a single frame (and not integrated under series GUI)
- if slices in RTStruct are not adjacent then interpolation between slices is performed
- diameter of circle3D and circle2D tools is displayed when tool size is changed
- color palette is now unique for each frame.

## Fixed issue

- multiple acquisitionNumber in one study
- application of orientation volume when loading from DICOMDIR





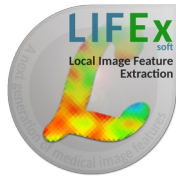
LIFEx v6.00

Annoucement

— LIFEx —

# CONTENTS

- 
- Main update
  - Texture update
  - New Labeling protocol
  - New DSC-MR protocol



# LIFEx v6.00

## Annoucement

— LIFEx —

# Texture updates

C. Nioche, F. Orlhac, I. Buvat

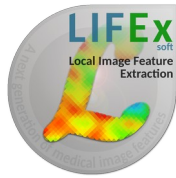
Added / Improved

### Added

- 2D or 3D processing setting
- 4D or temporal 3D of local texture (map) is available
- 2D processing of GLCM features in coronal and sagittal views

### Improved

- "sessionXls" is changed into "SessionCsv" in script files
- result file is changed to \*.csv instead of \*.xls (too many problems with excel files)
- "check ROI for texture" is moved from ROI tools to Texture GUI
- checking the number of voxels compatible with textural feature calculations (64 for 3D ROI, 16 for 2D ROI) has moved after voxel resampling
- processing of GLZLM matrix and SUVpeak is faster
- remove all hash and space characters on column title in csv ouput file
- "NaN" values in result file when these values are not calculated
- the session result file has its name set automatically and fixed; It is created and appended automatically
- time frame is calculated in texture calculation, time column is added to the result file



# LIFEx v6.00

Annoucement

— LIFEx —

# Texture updates

C. Nioche, F. Orhac, I. Buvat

Added / Updated

## Add new features

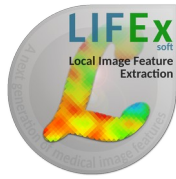
- SHAPE\_surface
- CONVENTIONAL\_AgatstonScore,
- DISCRETIZED\_min, \_mean, \_std, \_max,
- DISCRETIZED\_Q1, \_Q2, \_Q3
- DISCRETIZED\_Skewness, \_Kurtosis, \_ExcessKurtosis,
- DISCRETIZED\_peakSphere0.5mL, \_peakSphere1mL,
- DISCRETIZED\_AgatstonScore,
- DISCRETIZED\_TLG(mL),
- DISCRETIZED\_RIM\_min, \_RIM\_mean, \_RIM\_stddev, \_RIM\_max, \_RIM\_sum
- DISCRETIZED\_HISTO\_Skewness
- DISCRETIZED\_HISTO\_Kurtosis
- DISCRETIZED\_HISTO\_ExcessKurtosis

## Update features

- SHAPE\_sphericity
- SHAPE\_compacity

## Rename former

- HISTO\_Skewness feature into CONVENTIONAL\_Skewness feature
- HISTO\_Kurtosis feature into CONVENTIONAL\_Kurtosis feature
- HISTO\_ExcessKurtosis feature into CONVENTIONAL\_ExcessKurtosis
- HISTO\_Entropy\_log10 feature into DISCRETIZED\_HISTO\_Entropy\_log10
- HISTO\_Entropy\_log2 feature into DISCRETIZED\_HISTO\_Entropy\_log2
- HISTO\_Energy feature into DISCRETIZED\_HISTO\_Energy



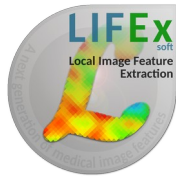
LIFEx v6.00

Annoucement

— LIFEx —

# CONTENTS

- Main update
- Texture update
- New Labeling protocol
- New DSC-MR protocol



# LIFEx v6.00

Annoucement

— LIFEx —

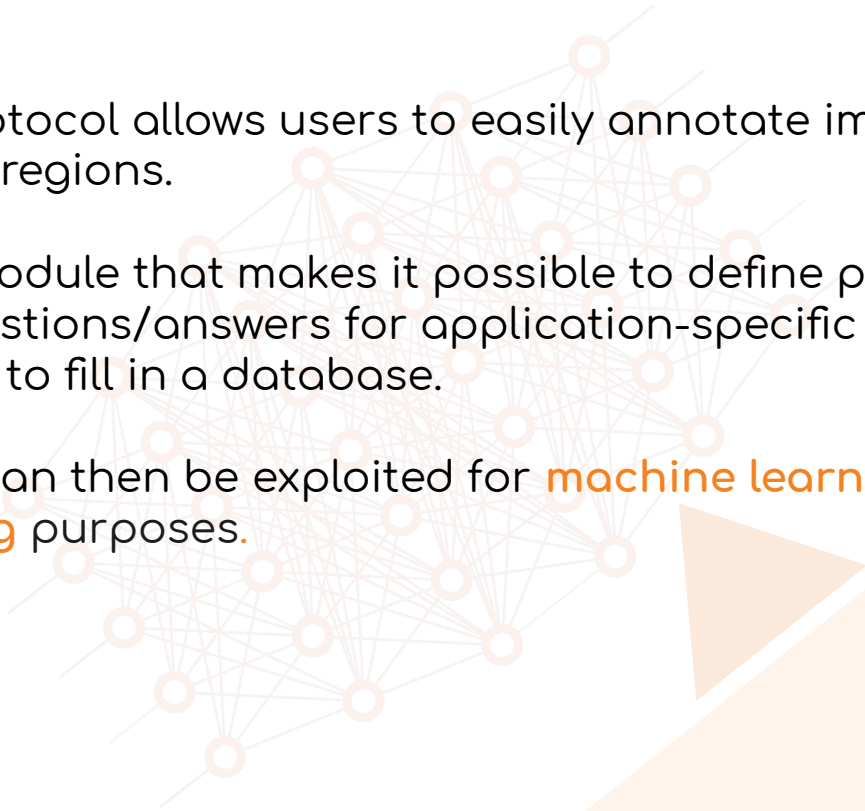
# New labeling protocol

C. Nioche, F. Orthac, I. Buvat

The labeling protocol allows users to easily annotate images and associated regions.

It is a generic module that makes it possible to define pre-established questions/answers for application-specific annotation and to fill in a database.

This database can then be exploited for **machine learning** or **deep learning** purposes.





# LIFEx v6.00

Annoucement  
— LIFEx —

# New labeling protocol

C. Nioche, F. Orhac, I. Buvat

The screenshot displays the LIFEx v6.00 software interface. The main window shows a PET scan with a highlighted ROI. The interface is divided into several panels:

- Protocol list:** Shows various protocols such as Texture Feature Extraction, MTV Notation, and the selected **Labeling Computer-assisted label...** protocol.
- Patients Selector:** A panel on the left showing a list of patients, with **PT1 (3A, 3Δ)** and **CT1 (3A, 3Δ)** selected.
- ROI tools:** A vertical toolbar on the right containing tools for **Applied to one ROI:** (New, Load, Dispose), **Measure:** (Max, Angle, Dist), **Edit:** (Circle3D, Circle2D, Pencil2D), **Threshold:** (n, 40%, Nestle), **Applied to all ROI:** (Hide, Show, Sort), and **Label 0** configuration options (Organ\*, Comment, Nodule\*, Tumor grade\*, Voxel pick).
- Property input panel:** A panel at the bottom right for configuring the selected ROI, including fields for **Organ\***, **Comment**, **Nodule\*** (Yes/No), **Tumor grade\*** (I-IV), and **Voxel pick**.
- Central View:** A large central area displaying the PET scan with a highlighted ROI. A **patient selector** callout points to the Patients Selector panel, a **controller** callout points to the ROI tools panel, and a **property input panel** callout points to the bottom right configuration area.

Technical details visible in the interface include:
 

- Activity (SUVbw:g/mL):** 7.20
- Actual Frame Duration:** 75012 ms
- Radionuclide Total Dose:** 203389000 kBq
- Radionuclide Half Life:** 109.8 min
- Mag:** x2.3
- 4.0 thk/0.0 sp**
- zip: 144 x 144 pi**
- DFOV: 5.8 x 5.8 dm**
- vx: 4.00mm x 4.00mm**



# LIFEx v6.00

Annoucement  
— LIFEx —

# New labeling protocol

C. Nioche, F. Orhac, I. Buvat

Label 0

Organ\*

Comment

ROI

Nodule\*

Tumor grade\*

Voxel pick

## Properties form

The property entry form is built from the definitions given in the script. Each definition will be associated with a property and thus a dialog box.

## Patient Selector

Patient Selector shows the patients that still need to be annotated

Patients Selector

X PT1 (3Δ, 3Δ)

X CT1 (3Δ, 3Δ)



Several types of fields are available to define a complete form.

Tumor grade\*

- I
- II
- III
- IV

**Checkbox**  
property#.type=checkbox

Voxel pick

pick a voxel ->

**Voxel pick**  
property#.type=voxelpick

Comment\*

no empty

**Textfield**  
property#.type=textfield

ROI pick

ROI

**ROI pick**  
property#.type=roipick

Nodule\*

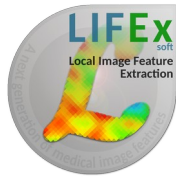
- Yes
- No

**Radiobutton**  
property#.type=radiobutton

Organ\*

**Dropdown**  
property#.type=dropdown





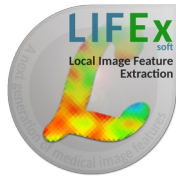
LIFEx v6.00

Annoucement

— LIFEx —

# CONTENTS

- Main update
- Texture update
- New Labeling protocol
- New DSC-MR protocol



# LIFEx v6.00

Annoucement

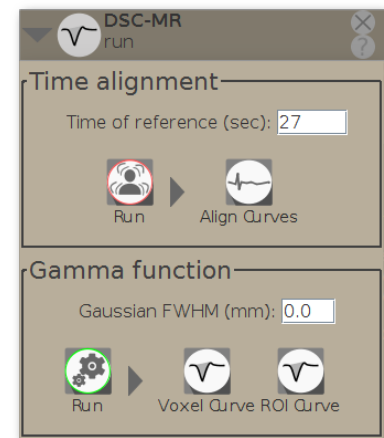
— LIFEx —

# DSC-MR protocol

C. Nioche, S. Desmidt, F. Frouin, I. Buvat

→ The DSC-MR protocol of LIFEx derives perfusion-related parameters using gadolinium-based dynamic image series methods.

This technique is the use of an exogenous, intravascular, nondiffusible contrast agent, usually a gadolinium-based contrast agent, that enhances the susceptibility effects on the echo signal, in first-pass dynamic susceptibility contrast-enhanced (DSC) MR imaging.





**LIFEx v6.00**  
 Annonce  
 — LIFEx —

# DSC-MR protocol

C. Nioche, S. Desmidt, F. Frouin, I. Buvat

rCVB result after DSC-MR perfusion calculation

