

LIFEx v6.30

Texture protocol

— LIFEx —

C. Nioche, F. Orlhac



How to extract features



LIFEx version 6.30

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Pre-requisites:

- Create an account on www.lifexsoft.org
- Install the LIFEx software
- Read the tutorial: *How to open and view Dicom images ?*
- Read the tutorial: *How to draw regions with LIFEx ?*
- Select the Texture protocol after opening the LIFEx application



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To extract features, you should draw at least one ROI.

The screenshot displays the LIFEx software interface with four main panels:

- Left Panel:** Contains navigation and protocol settings. It includes buttons for Patient, Film, Panel, Layout1, Sag, Ax, Cor, and MIP. The 'Texture' section is expanded, showing 'Spatial Resampling' (spacing X: 3.125, Y: 3.125, Z: 2.7732978) and 'Intensity Rescaling' (absolute bounds: min=0, max=20).
- Top-Left Panel (Sag):** Shows a sagittal PET/MR scan. Text includes: 'SIGNA PET/MR Ex:31', 'Head to Thighs 3D MAC', 'LIFE:PTMRDemo', 'M 54Y 66.0 Kg', 'X: 96 pi, HFS', 'Head to Thighs 3D MAC, (96, 96, 198)=2.29 SUV', 'Acc: 02/10/15 15:21:55 (SUV)', and 'alpha(%) 100'. Technical details include: 'Actual Frame Duration: 240000 ms', 'Mag: x0.3', 'Radionuclide Total Dose: 258000 kBq', '2.7 thk/0.0 sp', 'Radiopharmaceutical Start Time: 11:48:00', 'zip: 414 x 192 pi', 'Radiopharmaceutical Half Life: 109.7 min', 'DFOV: 129.3 x 60.0 cm', 'W: 11.802 L: 5.901', and 'vx: 3.1x3.1x2.7mm=27.0mm3'.
- Top-Right Panel (Ax):** Shows an axial PET/MR scan. Text includes: 'SIGNA PET/MR Ex:31', 'Head to Thighs 3D MAC', 'LIFE:PTMRDemo', 'M 54Y 66.0 Kg', 'Z: 199 pi, HFS', 'Head to Thighs 3D MAC, (77, 164, 199)=0.00 SUV', 'Acc: 02/10/15 15:21:55', and 'alpha(%) 100'. Technical details are identical to the sagittal view.
- Bottom-Left Panel (Cor):** Shows a coronal PET/MR scan. Text includes: 'SIGNA PET/MR Ex:31', 'Head to Thighs 3D MAC', 'LIFE:PTMRDemo', 'M 54Y 66.0 Kg', 'Y: 96 pi, HFS', 'Head to Thighs 3D MAC, (96, 96, 198)=2.29 SUV', 'Acc: 02/10/15 15:21:55 (SUV)', and 'alpha(%) 100'. Technical details are identical to the other views.
- Bottom-Right Panel:** Shows a zoomed-in axial view of a purple ROI. Text includes: 'Actual Frame Duration: 240000 ms', 'Mag: x2.2', 'Radionuclide Total Dose: 258000 kBq', '2.7 thk/0.0 sp', 'Radiopharmaceutical Start Time: 11:48:00', 'zip: 192 x 192 pi', 'Radiopharmaceutical Half Life: 109.7 min', 'DFOV: 60.0 x 60.0 cm', 'W: 11.802 L: 5.901', and 'vx: 3.1x3.1x2.7mm=27.0mm3'.
- Right Panel (ROI):** A window titled 'ROI' showing 'Applied to one ROI:' and 'Applied to all ROI:' sections. The 'Applied to one ROI:' section includes 'File' (Load, Save, Delete), 'Tools' (New, Empty, CheckTex), 'Measure' (Max, Angle, Dist), 'Draw' (Circle3D, Circle2D, Click), and 'Threshold' (n, 40%, Nestle). The 'Applied to all ROI:' section includes 'Tools' (Hide, Show, Sort). A red box highlights a specific ROI window titled 'C1_Rel_thres40.0' with a value of '34.39 cm3 (1270vx ref)'. Below this window, a 'Drag ROIs' section shows a 'Drop here' icon and a list of file types: '- nii', '- nii.gz', and '- RTSTRUCT'.



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Before computing features, you can check the VOI with the CheckTex icon. The function determines whether the VOI contains enough connected voxels (more than 64).

The screenshot displays the LIFEx software interface with four main panels:

- Top Left:** Patient information (DEA-SHFJ, France - v3.68), navigation tools (Sag, Ax, Cor, MIP), and graph units (Unit X: sec, Unit Y: SUV).
- Top Middle:** Sagittal PET/MR scan (Sag LIFEx - Sag) showing a region of interest (ROI) in the head/thighs area. Parameters include: Ex:31, Head to Thighs 3D MAC, X: 96 pi, YFS, Acc: 02/10/15 15:21:55 (SUV), alpha(%) 100, and Head to Thighs 3D MAC, (96, 96, 198)=2.29 SUV.
- Top Right:** Axial PET/MR scan (Ax LIFEx - Ax) showing the same ROI. Parameters include: Ex:31, Head to Thighs 3D MAC, X: 199 pi, YFS, Acc: 02/10/15 15:21:55, and Head to Thighs 3D MAC, (77, 164, 199)=0.00 SUV.
- Bottom Left:** Coronal PET/MR scan (Cor LIFEx - Cor) showing the ROI. Parameters include: Ex:31, Head to Thighs 3D MAC, Y: 96 pi, YFS, Acc: 02/10/15 15:21:55 (SUV), alpha(%) 100, and Head to Thighs 3D MAC, (96, 96, 198)=2.29 SUV.
- Bottom Middle:** A zoomed-in view of the ROI, showing a purple-colored region on a grayscale background.
- Bottom Right:** ROI analysis panel (ROI) showing statistics for 'C1_Rel_thres40 0' (34.39 cm3 (1270vx ref)). Statistics include: 2D alpha:31%, max: 13.99 SUV, mean: 8.75±1.91 SUV, min: 5.59 SUV, sum: 11118.08 SUV, nbVx on ref: 1270 vx, size: 34.39 cm3, coordMax: [z210.00, y105.00].

The 'CheckTex' icon in the ROI panel is highlighted with a red box, indicating its function to verify the ROI's connectivity.



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To calculate texture features, first, choose the spatial resampling (to use default settings, click on the icon on the right).

The screenshot displays the LIFEx software interface with several panels:

- Left Panel:** Contains navigation and tool icons. The **Texture** section is highlighted with a red box, showing the **Spatial Resampling** settings: spacing X (mm): 3.125, spacing Y (mm): 3.125, spacing Z (mm): 2.7732978. Below it are **Intensity Rescaling** and **Intensity Discretization** options.
- Top Panels:** Display PET/CT scans in Sagittal (Sag), Axial (Ax), and Coronal (Cor) views. The **ROI** panel on the right shows a purple ROI on the axial view.
- Right Panel:** The **ROI** panel shows the **Applied to one ROI:** section with icons for File (Load, Save, Delete), Tools (New, Empty, CheckTex), Measure (Max, Angle, Dist), Draw (Circle3D, Circle2D, Click), and Threshold (n, 40%, Nestle). Below this is the **Applied to all ROI:** section with Hide, Show, and Sort tools. A detailed ROI statistics window is open, showing: **C1_Rel_thres40.0**, **2D alpha: 31%**, **34.39 cm³ (1270 vx ref)**, and various SUV metrics (max: 13.99, mean: 8.75±1.91, min: 5.59, sum: 11118.08, nbVx on ref: 1270, size: 34.39 cm³, coordMax: [z210.00, y105.00]).
- Bottom Panel:** Shows technical parameters for the scans, including Actual Frame Duration, Radionuclide Total Dose, Radiopharmaceutical Start Time, Radiopharmaceutical Half Life, and DFOV.



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Second, choose the intensity resampling method: absolute (between two fixed bounds) or relative (between the minimum and the maximum in the VOI or between mean - 3SD and mean + 3SD, with SD: standard deviation of voxel values in the VOI).

The screenshot displays the LIFEx software interface with four main panels:

- Left Panel (Tools):** Contains various tool icons for patient management, image navigation (Sag, Ax, Cor, MIP), and texture analysis settings. The **Texture** section is expanded to show **Spatial Resampling** and **Intensity Rescaling** options. The **Intensity Rescaling** section is highlighted with a red box, showing three radio buttons: **absolute (bounds: min<->max)** (selected), **relative (ROI: min<->max)**, and **relative (ROI: mean±-3sd)**. Below it, the **Intensity Discretization** section shows **Nb of grey levels: 64** and **size of bins: 0.3125**.
- Top Panels (Sagittal and Axial Views):** Display PET/MR scans. The sagittal view (LIFEx - Sag) shows a patient's body with a purple ROI on the head. The axial view (LIFEx - Ax) shows a cross-section of the head with a purple ROI. Both views include patient information: **SIGNA PET/MR Ex:31**, **Head to Thighs 3D MAC**, **LIFExPTMRDemo**, **M 54 Y 66.0 Kg**, **Z: 199 pi**, **HFS**, **Acc: 02/10/15 15:21:55 (SUV)**, and **Head to Thighs 3D MAC, (96, 96, 198)=2.29 SUV**. Technical parameters include **Actual Frame Duration: 240000 ms**, **Mag: x0.3**, **Radionuclide Total Dose: 258000 kBq**, **2.7 thk/0.0 sp**, **2.7 thk/0.0 sp**, **Radionuclide Half Life: 109.7 min**, **DFOV: 129.3 x 60.0 cm**, **W: 11.802 L: 5.901**, and **vx: 3.1x3.1x2.7mm=27.0mm3**.
- Bottom Panel (Coronal View):** Shows a coronal PET/MR scan with a purple ROI. It includes the same patient information and technical parameters as the other views, with **Mag: x0.4**.
- Right Panel (ROI):** Shows the **ROI** window with a **2D alpha: 31%** slider and a **Drop here** area for file selection. The **Applied to one ROI:** section includes **File** (Load, Save, Delete), **Tools** (New, Empty, CheckTex), **Measure** (Max, Angle, Dist), **Draw** (Circle3D, Circle2D, Click), and **Threshold** (n, 40%, Nestle) options. The **Applied to all ROI:** section includes **Tools** (Hide, Show, Sort) options. The **Drop here** area lists **from files:** **- nii**, **- nii.gz**, and **- RTSTRUCT**.



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Third, choose the intensity discretization: the number of grey levels after discretization or the size of bins (for more details, please see *Texture User Guide*).

The screenshot displays the LIFEx software interface with four main panels:

- Left Panel (Tools):** Contains navigation and analysis tools. The **Texture** section is expanded, showing **Spatial Resampling** (spacing X: 3.125 mm, Y: 3.125 mm, Z: 2.7732978 mm) and **Intensity Rescaling** (absolute bounds: 0 to 20). The **Intensity Discretization** section is highlighted with a red box, showing **Nb of grey levels: 64** and **size of bins: 0.3125**.
- Top Panels (Sagittal and Axial views):** Display PET/MR scans. The sagittal view shows a vertical scan with a purple ROI. The axial view shows a cross-section with a purple ROI. Both views include patient information: **SIGNA PET/MR Ex:31 Head to Thighs 3D MAC**, **LIFExPTMRDemo**, **M 54 Y 66.0 Kg**, **X: 96 pi, HFS**, **Head to Thighs 3D MAC, (96, 96, 198)=2.29 SUV**, and **Acc: 02/10/15 15:21:55 (SUV)**.
- Bottom Panels (Coronal and Axial views):** Display PET/MR scans. The coronal view shows a vertical scan with a purple ROI. The axial view shows a cross-section with a purple ROI. Both views include patient information: **SIGNA PET/MR Ex:31 Head to Thighs 3D MAC**, **LIFExPTMRDemo**, **M 54 Y 66.0 Kg**, **Y: 96 pi, HFS**, **Head to Thighs 3D MAC, (96, 96, 198)=2.29 SUV**, and **Acc: 02/10/15 15:21:55 (SUV)**.
- Right Panel (ROI):** Shows the **Applied to one ROI:** section with **File** (Load, Save, Delete), **Tools** (New, Empty, CheckTex), **Measure** (Max, Angle, Dist), **Draw** (Circle3D, Circle2D, Click), and **Threshold** (n, 40%, Nestle) options. Below this is the **Applied to all ROI:** section with **Tools** (Hide, Show, Sort) options. At the bottom, there is a **Drop here** area for **Drag ROIs** from files (nii, nii.gz, RTSTRUCT).



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Click on Run icon to compute features.

The screenshot displays the LIFEx software interface with three main windows: Sagittal (Sag), Coronal (Cor), and Axial (Ax) views of a PET/MR scan. The interface includes a left sidebar with various toolbars and a right sidebar with ROI management tools.

Used protocols: CEA-SHFJ, France - v3.68

Texture Feature Extraction Settings:

- Spatial Resampling: spacing X (mm): 3.125, spacing Y (mm): 3.125, spacing Z (mm): 2.7732978
- Intensity Rescaling: absolute (bounds: min->max), min bound: 0, max bound: 20
- Intensity Discretization: Nb of grey levels: 64, size of bins: 0.3125
- advanced settings: Run icon highlighted in a red box

ROI Management Tools:

- Applied to one ROI: File (Load, Save, Delete), Tools (New, Empty, CheckTex), Measure (Max, Angle, Dist), Draw (3D, 2D, Circle2D, 3D), Threshold (n, 40%, Nestle)
- Applied to all ROI: Tools (Hide, Show, Sort)
- ROI List: C1_Rel_thres40.0, 34.39 cm3 (1270vx ref)
- 2D alpha: 31 %
- Head to Thighs 3D MAC: max: 13.99 SUV, mean: 8.75±1.91 SUV, min: 5.59 SUV, sum: 11118.08 SUV, nbVx on ref: 1270 vx, size: 34.39 cm3, coordMax: [z210.00, y105.00]
- Drag ROIs: Drop here

Scan Data (Sag, Cor, Ax):

- Modality: SIGNA PET/MR
- Exam: Ex:31
- Protocol: Head to Thighs 3D MAC
- Coordinates: X: 96 pi, Y: 96 pi, Z: 199 pi
- Activity: Acc: 02/10/15 15:21:55 (SUV)
- Texture: LIFE:PTMPDermo
- Actual Frame Duration: 240000 ms
- Radionuclide Total Dose: 258000 kBq
- Radionuclide Half Life: 109.7 min
- DFOV: 129.3 x 60.0 cm
- W: 11.802 L: 5.901
- vx: 3.1x3.1x2.7mm=27.0mm3
- Mag: x0.3 (Sag), x0.4 (Cor), x2.2 (Ax)



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Click on Yes to save results in a previously created csv file.
Click on No to save results in a new csv file.

The screenshot displays the LIFEx software interface with a PET/CT scan. A dialog box titled "Save in previous file" is centered on the screen, asking: "Would you like to save your results in your previous session xis file?". The dialog has "Yes" and "No" buttons.

The interface includes several panels:

- Used protocols:** CEA-SHFJ, France - v3.68
- Texture Feature Extraction:** Spatial Resampling (spacing X: 3.125, Y: 3.125, Z: 2.7732978) and Intensity Rescaling (absolute, min bound: 0, max bound: 20).
- Status:** Texture of C1_Rel_thres40 Processing [end] and Creation of XL file [OK] LIFExPTMRDEMO_LIFExPTMRDE MO_Texture_1520257984750.xis
- ROI Panel:** Applied to one ROI and Applied to all ROI. Tools include File (Load, Save, Delete), Tools (New, Empty, CheckTex), Measure (Max, Angle, Dist), Draw (3D, 2D, Circle2D, Circle3D), and Threshold (n, 40%, Nestle).

Technical data for the scan is displayed in the bottom right of each view:

- Sagittal View:** Actual Frame Duration: 240000 ms, Radionuclide Total Dose: 258000 kBq, Radiopharmaceutical Start Time: 11:48:00, Radiopharmaceutical Half Life: 109.7 min, DFOV: 129.3 x 60.0 cm, W: 11.802 L: 5.901, vx: 3.1x3.1x2.7mm=27.0mm3, Mag: x0.3
- Coronal View:** Actual Frame Duration: 240000 ms, Radionuclide Total Dose: 258000 kBq, Radiopharmaceutical Start Time: 11:48:00, Radiopharmaceutical Half Life: 109.7 min, DFOV: 129.3 x 60.0 cm, W: 11.802 L: 5.901, vx: 3.1x3.1x2.7mm=27.0mm3, Mag: x0.4
- Axial View:** Actual Frame Duration: 240000 ms, Radionuclide Total Dose: 258000 kBq, Radiopharmaceutical Start Time: 11:48:00, Radiopharmaceutical Half Life: 109.7 min, DFOV: 60.0 x 60.0 cm, W: 11.802 L: 5.901, vx: 3.1x3.1x2.7mm=27.0mm3, Mag: x2.2



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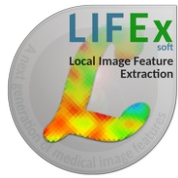
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If several ROI were selected, all results are stored in a single file with one row for each ROI.

The screenshot displays the LIFEx software interface with several windows and panels:

- Left Panel:** Contains navigation and analysis tools. The 'Texture' section is active, showing 'Spatial Resampling' (spacing X: 3.125, Y: 3.125, Z: 2.7732978) and 'Intensity Rescaling' (absolute bounds: min=0, max=20).
- Top Windows:** 'Sag LIFEx - Sag' and 'Ax LIFEx - Ax' show PET/MR scans. The 'Sag' window displays 'Head to Thighs 3D MAC' with a value of 2.68 SUV. The 'Ax' window displays 'Head to Thighs 3D MAC' with a value of 4.24 SUV.
- Right Panel:** 'ROI' window showing 'Applied to one ROI' and 'Applied to all ROI' toolsets. A list of ROIs is visible:
 - C1_Rel_thres40.0 (34.39 cm3 (1270vx ref))
 - C2_Rel_thres40.0 (6.420 cm3 (226vx ref))
 - C3_Rel_thres40.0 (31.63 cm3 (1168vx ref))
- Bottom Window:** 'INFO_PatientName' table showing results for three ROIs:

	F	G	H
1	INFO_ActualFrameDuration	INFO_NameOfRoi	
2	4.0 min	C1_Rel_thres40.0	
3	4.0 min	C2_Rel_thres40.0	
4	4.0 min	C3_Rel_thres40.0	



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Click on advanced settings icon to add/remove features, modify texture parameters (distance with neighbors) and save the texture matrices.

The screenshot shows the LIFEx software interface with the 'Advanced Settings' dialog box open. The background displays a PET scan image with a purple ROI. The 'Advanced Settings' dialog is divided into three main sections:

- First Order:**
 - Shape:** SHAPE_Sphericity, SHAPE_Compacity, SHAPE_Volume
 - Histogram:** HISTO_Skewness, HISTO_Kurtosis, HISTO_Entropy, HISTO_Energy
 - Conventional:** CONV_SUV (min, mean, max), CONV_SUVpeak 0.5mL, CONV_SUVpeak 1mL, CONV_TLG
- Second Order:**
 - GLCM:** vx : distance with neighbours, GLCM_Homogeneity, GLCM_Energy, GLCM_Contrast, GLCM_Correlation, GLCM_Entropy, GLCM_Dissimilarity
 - GLRM:** GLRM_SRE, GLRM_LRE, GLRM_LGRE, GLRM_HGRE, GLRM_SRHGE, GLRM_SRLGE, GLRM_LRLGE, GLRM_LRHGE, GLRM_GLNU, GLRM_RLNU, GLRM_RP
 - NGLDM:** NGLDM_Coarseness, NGLDM_Contrast, NGLDM_Busyness
 - GLZLM:** GLZLM_SRE, GLZLM_LZE, GLZLM_LGZE, GLZLM_HGZE, GLZLM_SZLGE, GLZLM_SZHGE, GLZLM_LZLGE, GLZLM_LZHGE, GLZLM_GLNU, GLZLM_ZLNU, GLZLM_ZP
- Output:**
 - ROI Output:** main xLS format, main CSV format
 - Histogram Output:** Show histogram, Save histogram in file
 - Matrix Output:** Save GLCM in file in each direction, Save GLRLM in file, Save NGLDM in file, Save GLZLM in file

The main interface also shows various protocol parameters on the left and bottom, such as 'Spatial Resampling' (spacing X, Y, Z) and 'Intensity Rescaling' (absolute/relative). The bottom status bar provides technical details like 'Actual Frame Duration: 240000 ms' and 'Radiopharmaceutical Start Time: 11:48:00'.



If you have questions, please read the online documentation:
<https://www.lifexsoft.org/index.php/resources/documentation>

or contact us: contact@lifexsoft.org