
Carney's bilinear scaling

This function converts a given low-dose CT image to CT-umap, by using carney's transformation technique Literature: (Carney et.al, 2006, Transforming CT images for attenuation correction in PET/CT) Author: Lalith Kumar Shiyam Sundar, M.Sc. Date: Feb 15, 2018 Quantitative Imaging and Medical Physics, Medical University of Vienna. Inputs: pathOfCTdicom: Path of the CT dicom series (low-dose) CTimgToScale: The low-dose CT volume, which needs to be converted to a u-map. Outputs: CTuMap: The CT attenuation map, scaled using carney's functions.

Usage: pathOfCTdicom= 'users/desktop/AC_CT_XYZ'; CTimgToScale=CTvolume; % matlab 3D matrix
CTuMap=carneyBilinearScaling(pathOfCTdicom,CTimgToScale); % press enter.

```
function CTuMap=carneyBilinearScaling(pathOfCTdicom,CTimgToScale)

% Parameters for Bilinear scaling, choose a, b and BP.
cd(pathOfCTdicom);
CTfiles=dir;
CTfiles=CTfiles(arrayfun(@(x) x.name(1), CTfiles) ~= '.'); % reading
the files inside the folder.
CTdcmInfo=dicominfo(CTfiles(1).name);
TubeVoltage=CTdcmInfo.KVP;
scalingFactorSoftTissue=9.6e-005;
switch TubeVoltage % these values are obtained from the literature
(Carney et.al, 2006, Transforming CT images for attenuation
correction in PET/CT)
    case 80
        a = 3.64e-005;
        b = 6.26e-002;
        BP = 1050; % (HU+1000) based on scaled components (0 to 4000)
    case 100
        a = 4.43e-005;
        b = 5.44e-002;
        BP = 1052;
    case 110
        a = 4.92e-005;
        b = 4.88e-002;
        BP = 1043;
    case 120
        a = 5.10e-005;
        b = 4.71e-002;
        BP = 1047;
    case 130
        a = 5.51e-005;
        b = 4.24e-002;
        BP = 1037;
    case 140
        a = 5.64e-005;
        b = 4.08e-002;
        BP = 1030;
end

% Scaling the CT using the bilinear coefficients.
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disp(['Low-dose CT to u-map conversion parameters:
',num2str(scalingFactorSoftTissue),', ',num2str(a),', ',num2str(b),', ',
',num2str(BP), '!']);
CTbelowBPmask=CTimgToScale<=(BP+23); % Siemens recommends using 1070
for segmenting bone and soft-tissue, this value can be seen in the e7
tools.
CTbelowBP=CTimgToScale.*(CTbelowBPmask);
CTbelowBPto511KeV=(scalingFactorSoftTissue).*(CTbelowBP).*CTbelowBPmask; %
Values in linear attenuation coefficients, units cm^-1
CTaboveBPMask=CTimgToScale>(BP+23);
CTaboveBP=CTimgToScale.*(CTaboveBPMask);
CTaboveBPto511KeV=((a.*(CTaboveBP))+b).*CTaboveBPMask; % values in
linear attenuation coefficients, units cm^-1
CTKVPto511KeV=CTbelowBPto511KeV+CTaboveBPto511KeV;
CTKVPto511KeV=(10000.*CTKVPto511KeV); % specially scaled for siemens
mMR reconstruction.
CTKVPto511KeV(CTKVPto511KeV<0)=0;
CTuMap=CTKVPto511KeV;
end
```

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