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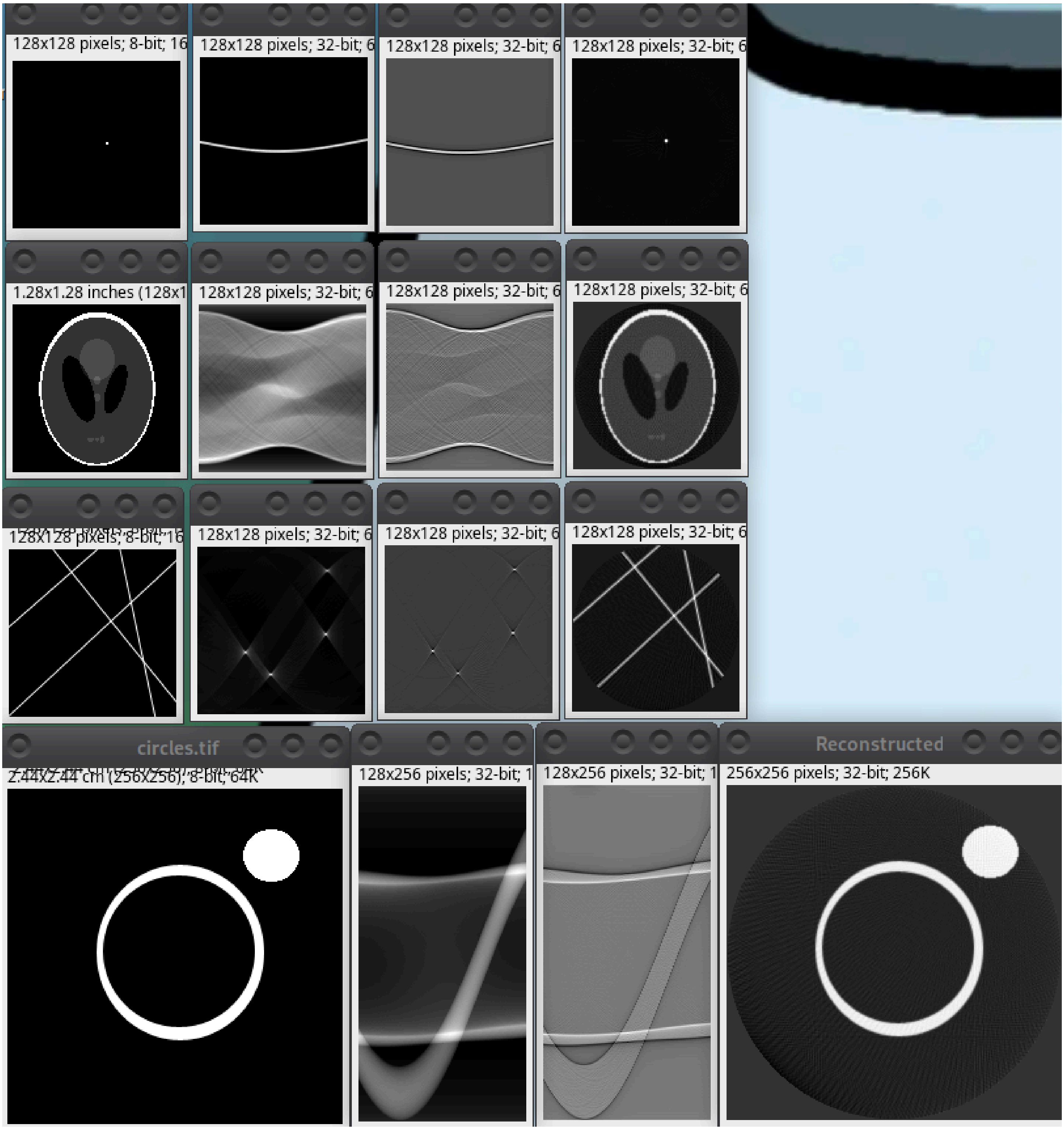
Relatorio.doc Transformada de Radon e retro-projeção

Solução Questão 1


128x128 pixels; 8-bit; 16
128x128 pixels; 32-bit; 6
128x128 pixels; 32-bit; 6
128x128 pixels; 32-bit; 6
1.28x1.28 inches (128x1
128x128 pixels; 32-bit; 6
128x128 pixels; 32-bit; 6
128x128 pixels; 32-bit; 6
128x128 pixels; 8-bit; 16
128x128 pixels; 32-bit; 6
128x128 pixels; 32-bit; 6
128x128 pixels; 32-bit; 6
circles.tif
2.44x2.44 cm (256x256); 8-bit; 64K
128x256 pixels; 32-bit; 1
128x256 pixels; 32-bit; 1
Reconstructed
256x256 pixels; 32-bit; 256K

Solução Questão 2. Transformada de retro-projeção

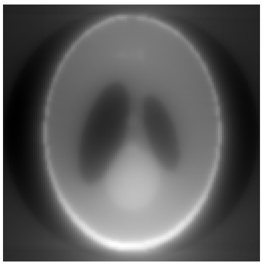
Código:

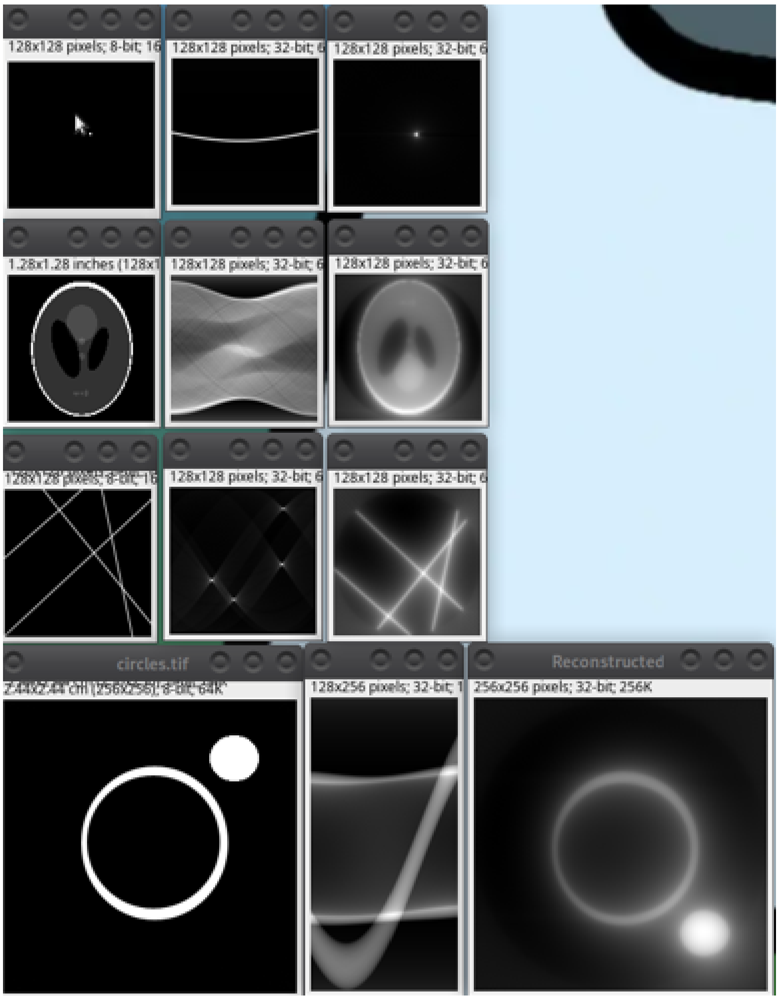
```java
public static ImageAccess inverseRadon(ImageAccess sinogram) {
    int nbAngles = sinogram.getWidth();
    int size     = sinogram.getHeight();
    double b[][] = new double[size][size];

    for (int i = 0; i < size; i++) {
        for (int j = 0; j < size; j++) {
            b[i][j] = 0.0;
        }
    }

    double[][] sinogramData = new double[nbAngles][size];
    for (int a = 0; a < nbAngles; a++) {
        for (int k = 0; k < size; k++) {
            sinogramData[a][k] = sinogram.getPixel(a, k);
        }
    }

    for (int i = 0; i < size; i++) {
        for (int j = 0; j < size; j++) {
            double sum = 0.0;
            double x = j - size / 2.0;
            double y = i - size / 2.0;

            for (int a = 0; a < nbAngles; a++) {
                double theta = a * Math.PI / nbAngles;
                double t = x * Math.cos(theta) + y * Math.sin(theta) + size / 2.0;

                double value = getInterpolatedPixel1D(sinogramData[a], t);
                sum += value;
            }
            b[i][j] = sum;
        }
    }

    ImageAccess reconstudedImage = new ImageAccess(b);
    return reconstudedImage;
}

private static double getInterpolatedPixel1D(double vector[], double t) {
    int index = (int) floor(t);
    double fraction = t - index;

    if (index < 0 || index >= vector.length - 1) {
        if (index == vector.length - 1 && fraction == 0)
```

```
            return vector[index];
        return 0.0;
    }

    double interpolatedValue = vector[index] * (1 - fraction) + vector[index + 1] * fraction;
    return interpolatedValue;
}
```

Teste:

Coloque uma imagem 8 bits





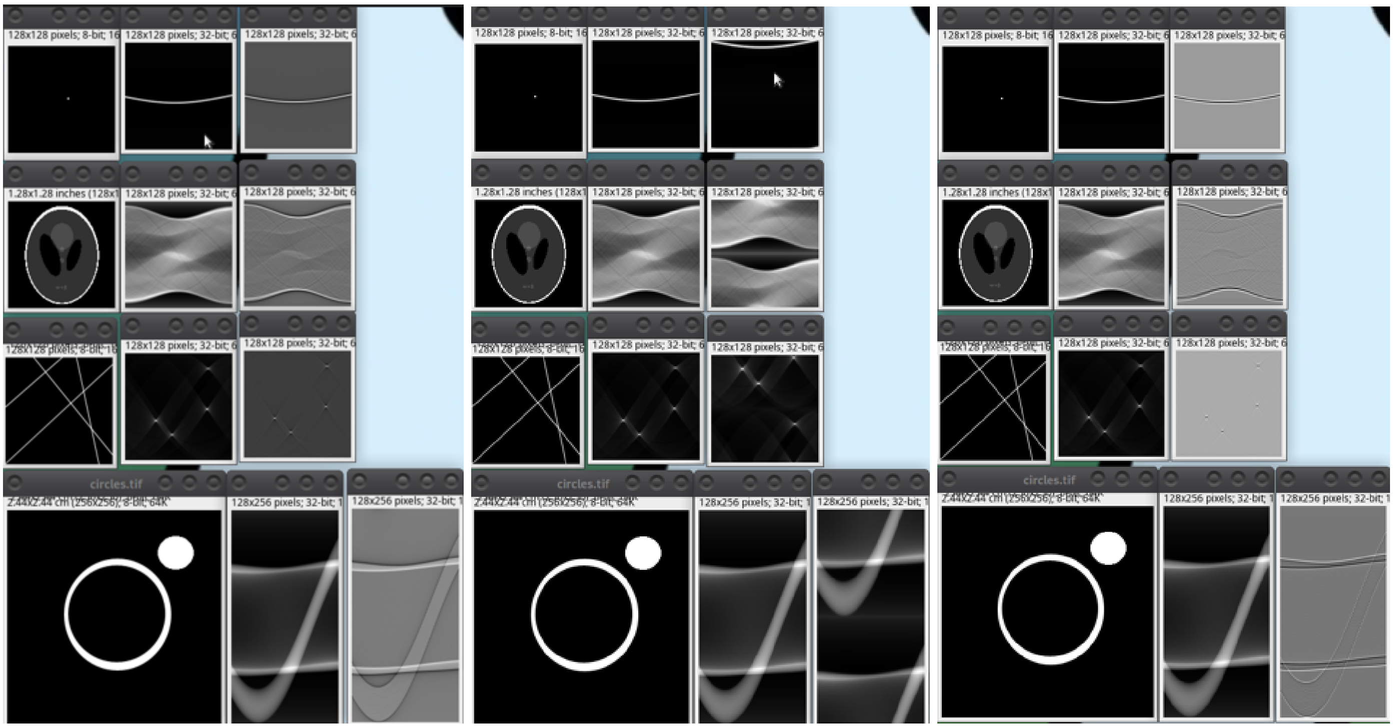
128x128 pixels; 8-bit; 16
128x128 pixels; 32-bit; 6
128x128 pixels; 32-bit; 6
1.28x1.28 inches (128x1
128x128 pixels; 32-bit; 6
128x128 pixels; 32-bit; 6
128x128 pixels; 8-bit; 16
128x128 pixels; 32-bit; 6
128x128 pixels; 32-bit; 6
circles.tif
2.44x2.44 cm (256x256); 8-bit; 64K
128x256 pixels; 32-bit; 1
Reconstructed
256x256 pixels; 32-bit; 256K

Solução Questão 3. Reconstrução de um sinograma

Código:

```
public static ImageAccess applyRamLakFilter(ImageAccess sinogram)
{
    int nbAngle = sinogram.getWidth();
    int size    = sinogram.getHeight();
    double[] real = new double[size];
    double[] imaginary = new double[size];
    double[] filter = generateRamLak(size);
    ImageAccess output = new ImageAccess(nbAngle, size);

    RadonFFT1D fft = new RadonFFT1D(size);

    for (int k=0; k<nbAngle; k++) {
        sinogram.getColumn(k, real);
        for(int l=0; l<size; l++) {
            imaginary[l] = 0.0;
        }
        fft.transform(real, imaginary);
        for(int l=0; l<size; l++) {
            real[l]      = real[l] * filter[l];
            imaginary[l] = imaginary[l] * filter[l];
        }
        fft.inverse(real, imaginary);
        output.putColumn(k, real);
    }
    return output;
}

public static double[] generateRamLak(int size) {
    double[] filter = new double[size];
      int center = size / 2;

    for (int i = 0; i < size; i++) {
        double omega = i - center;
        filter[i] = Math.abs(omega);
    }

    return filter;
}

public static ImageAccess applyCosineFilter(ImageAccess sinogram) {
    int nbAngle = sinogram.getWidth();
    int size    = sinogram.getHeight();
    ImageAccess output = new ImageAccess(nbAngle, size);

    RadonFFT1D fft = new RadonFFT1D(size);
    double[] cosineFilter = generateCosine(size);
    for (int a = 0; a < nbAngle; a++) {
        double[] projReal = new double[size];
        double[] projImag = new double[size];

        for (int k = 0; k < size; k++) {
            projReal[k] = sinogram.getPixel(a, k);
            projImag[k] = 0.0;
        }

        fft.transform(projReal, projImag);

        for (int k = 0; k < size; k++) {
            projReal[k] *= cosineFilter[k];
            projImag[k] *= cosineFilter[k];
        }

        fft.inverse(projReal, projImag);

        for (int k = 0; k < size; k++) {
            output.putPixel(a, k, projReal[k]);
        }
    }

    return output;
}

public static double[] generateCosine(int size) {
    double[] filter = new double[size];
    int center = size / 2;

    for (int i = 0; i < size; i++) {
        double omega = Math.abs(i - center);
        filter[i] = omega * Math.cos(Math.PI * omega);
    }

    return filter;
}

public static ImageAccess applyLaplacianFilter(ImageAccess sinogram) {
    int nbAngle = sinogram.getWidth();
    int size    = sinogram.getHeight();
    ImageAccess output = new ImageAccess(nbAngle, size);

    for (int a = 0; a < nbAngle; a++) {
        for (int k = 0; k < size; k++) {
            double left, center, right;
            center = sinogram.getPixel(a, k);

            if (k == 0) {
                left  = sinogram.getPixel(a, 1);
                right = sinogram.getPixel(a, k + 1);
            } else if (k == size - 1) {
                left  = sinogram.getPixel(a, k - 1);
                right = sinogram.getPixel(a, size - 2);
            } else {
                left  = sinogram.getPixel(a, k - 1);
                right = sinogram.getPixel(a, k + 1);
            }

            double value = 1.0 * left - 2.0 * center + 1.0 * right;

            output.putPixel(a, k, value);
        }
    }

    return output;
}
```

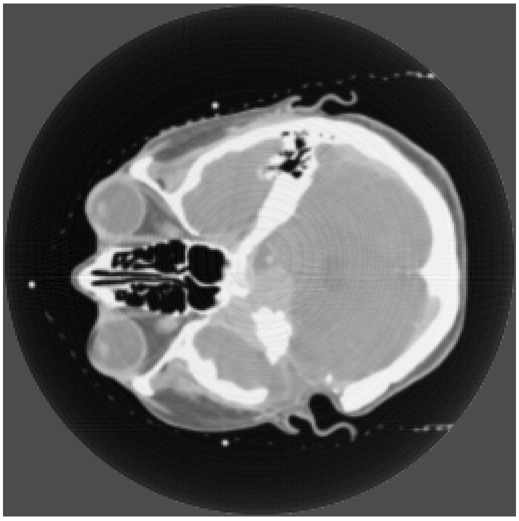
RamLak/Cosine/Laplace:


128x128 pixels; 8-bit; 16
128x128 pixels; 32-bit; 6
1.28x1.28 inches (128x1
circles.tif
2.44x2.44 cm (256x256); 8-bit; 64K
128x256 pixels; 32-bit; 1

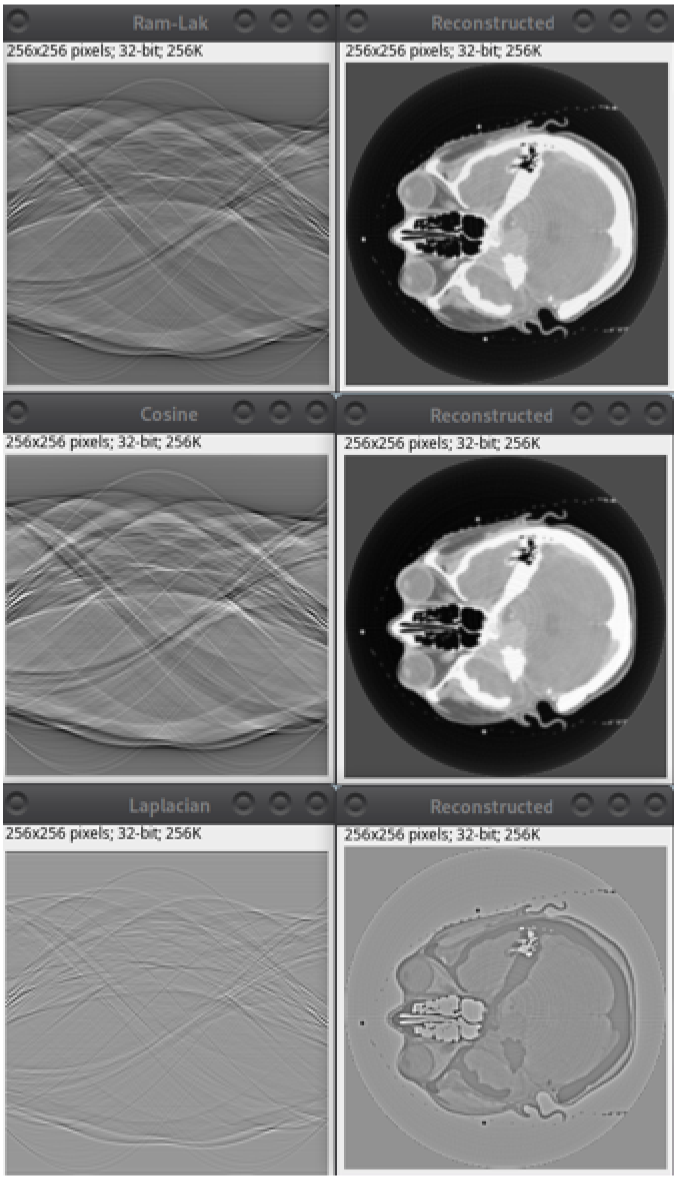
Solução Questão 4. Reconstrução de um sinograma

Filtro:

Coloque a imagem 8 bits



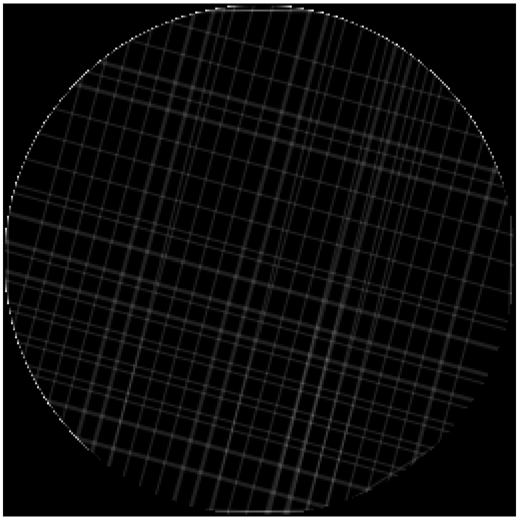
(RamLak)

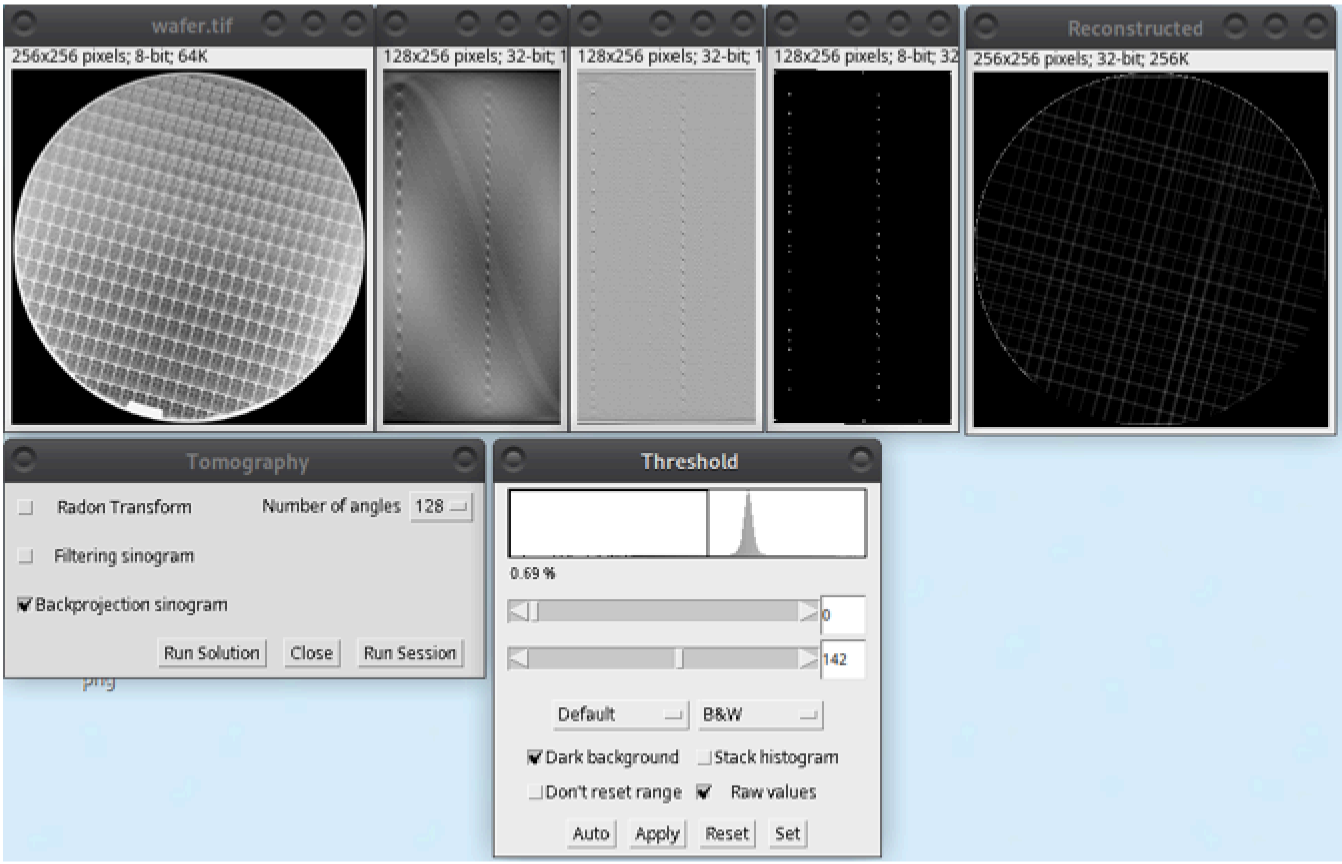

Ram-Lak
256x256 pixels; 32-bit; 256K
Reconstructed
256x256 pixels; 32-bit; 256K
Cosine
256x256 pixels; 32-bit; 256K
Reconstructed
256x256 pixels; 32-bit; 256K
Laplacian
256x256 pixels; 32-bit; 256K
Reconstructed
256x256 pixels; 32-bit; 256K

Solução Questão 5. Detecção de linhas

Filtro: Laplace
Valor Threshold: 142

Coloque a imagem 8 bits




wafer.tif
256x256 pixels; 8-bit; 64K
128x256 pixels; 32-bit; 1
128x256 pixels; 32-bit; 1
128x256 pixels; 8-bit; 32
Reconstructed
256x256 pixels; 32-bit; 256K
Tomography
Threshold
Run Solution
Close
Run Session
Auto
Apply
Reset
Set
png

☐ Radon Transform Number of angles 128

☐ Filtering sinogram

☑ Backprojection sinogram

0.69 %

0

142

Default B&W

☑ Dark background ☐ Stack histogram

☐ Don't reset range ☑ Raw values