3D cytomorphometry of volumetric imagery acquired by single cell tomographic imaging

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Cells from MCF10a and MDA-MD-231 were fixed and stained with absorption stains Hematoxylin and Eosin. One hundred cells of each type were imaged using Cell-CT and their reconstructed 3D images were subjected to robust, fully automated 3D image processing algorithms that computed morphological and textural descriptors (detailed below). Statistical analysis of computed features (detailed in associated excel file) provides insights into the structural properties of cells from the 2 cell lines.

Description of 3D structural (morphological and textural) features listed in data file

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Index | Feature name | units | Feature type | Feature description |
|  |  |  |  |  |
| 1 | Cell volume | µm3 | morphological |  |
| 2 | Nuclear volume | µm3 | “ |  |
| 3 | NC ratio | - | “ | Ratio of nuclear to cytoplasm volumes |
| 4 | Nuclear compactness | - | “ | Measure of roundness of nucleus |
| 5 | Number of nucleoli | - | “ |  |
| 6 | Total nucleolar volume | µm3 | “ | Volume of all nucleoli |
| 7 | Average nucleolar margination | µm | “ | Average distance of nucleolus centroid from nucleus centroidCentroid = center of mass |
| 8 |  DNA content (integrated optical density, IOD) | - | Textural | Optical density of all nuclear voxels; measure of total DNA content within nucleus |
| 9 | Mean optical density (MOD) | - | “ | Ratio of total optical density of nucleus to nuclear volume; measure of average DNA content  |
| 10 | Low DNA volume fraction | - | “ | Ratio of total volume of low optical density regions to nuclear volume ; ; measure of low density DNA distribution |
| 11 | Medium DNA volume fraction | - | “ | Ratio of total volume of medium optical density regions to nuclear volume; measure of medium density DNA distribution  |
| 12 | High DNA volume fraction | - | “ | Ratio of total volume of high optical density regions to nuclear volume ; measure of high density DNA distribution |
| 13 | Low OD content fraction | - | “ | Ratio of integrated low optical density to IOD |
| 14 | Medium OD content fraction | - | “ | Ratio of integrated medium optical density to IOD |
| 15 | High OD content fraction | - | “ | Ratio of integrated high optical density to IOD |
| 16 | Extinction ratio (ER)-LowMedium | - | “ | Ratio of mean optical density of low density DNA regions to that of medium density DNA regions; high values indicate smooth transitions |
| 17 | ER-LowHigh | - | “ | Ratio of mean optical density of low density DNA regions to that of high density DNA regions; high values indicate smooth transitions |
| 18 | ER-Low\_MediumHigh | - | “ | Ratio of mean optical density of low density DNA regions to that of medium & high density DNA regions; high values indicate smooth transitions |
| 19 | Number of low OD objects | - | “ | Count of discrete low density DNA particles |
| 20 | Number of medium OD objects | - | “ | Count of discrete medium density DNA particles |
| 21 | Number of high OD objects | - | “ | Count of discrete high density DNA particles |
| 22 | Low OD compactness | - | “ | Extent of roundness of discrete low density objects |
| 23 | Medium OD compactness | - | “ | Extent of roundness of discrete medium density objects |
| 24 | High OD compactness | - | “ | Extent of roundness of discrete high density objects |
| 25 | lowODsymmetry | µm | “ | Average distance between nuclear center and center of mass of low density DNA regions ; measure of symmetry of DNA distribution (0 if symmetric) |
| 26 | mediumODsymmetry | µm | “ | Average distance between nuclear center and center of mass of medium density DNA regions; measure of symmetry of DNA distribution (0 if symmetric) |
| 27 | highODsymmetry | µm | “ | Average distance between nuclear center and center of mass of high density DNA regions; measure of symmetry of DNA distribution (0 if symmetric) |
| 28 | MediumHighODsymmetry | µm | “ | Average distance between nuclear center and center of mass of medium&high density DNA regions; measure of symmetry of DNA distribution (0 if symmetric) |
| 29 | Markovian contrast (for a voxel offset of ‘d’) | a.u. | “ | Measure of uniformity in chromatin organization |
| 30 | Markovian correlation (for a voxel offset of ‘d’) | a.u. | “ | Measure of uniformity in chromatin organization |
| 31 | Markovian energy (for a voxel offset of ‘d’) | a.u. | “ | Measure of uniformity in chromatin organization |
| 32 | Markovian homogeneity (for a voxel offset of ‘d’) | a.u. | “ | Measure of uniformity in chromatin organization |