

CLAIMS

1. A method for surgical resection pre-operative planning of a mass, the mass comprising a plurality of internal features, the method comprising the steps of:

5 modelling the mass based on a plurality of physical dimensions;
determining a plurality of safety margins around ~~a plurality of~~ the internal features within the mass;

simulating a resection surface on the mass comprising a plurality of triangles;

10 optimizing local area and position of a first of the plurality of triangles on the resection surface based on a triangle-based algorithm and taking into account the plurality of safety margins;

updating the simulation of the resection surface; and

15 repeating the steps of optimizing and updating for each of the plurality of triangles on the resection surface.

2. The method in accordance with claim 1, wherein the step of optimizing local area and position of a first of the plurality of triangles on the resection surface based on a triangle-based algorithm comprises the steps of:

20 minimizing the local area around the first of the plurality of triangles;
and

configuring a distance between the first of the plurality of triangles and a first of the plurality of features to be greater than a safety margin around the first of the plurality of features, the safety margin being one of the plurality of

25 safety margins.

3. The method in accordance with claim 2, wherein the step of minimizing comprises:

modelling the minimization of the local area around the first of the plurality of triangles as a mathematical function;

5 applying a mathematical operation to the mathematical function; and
approximating the mathematical function using an approximation to obtain a solution whereby the local area is minimized.

4. The method in accordance with claim 3, wherein the mathematical
10 function is a partial differential equation.

5. The method in accordance with claim 3 or 4, wherein the mathematical operation includes a Laplacian operator with edge swapping.

15 6. The method in accordance with any one of claims 3 to 5, wherein the approximation includes iterative approximation.

7. The method in accordance with any one of claims 2 to 6, wherein the step of configuring comprises:

20 considering if the first of the plurality of triangles is within the safety margin around the first of the plurality of features; and

when the first of the plurality of triangles is within the safety margin around the first of the plurality of features, moving the first of the plurality of triangles along a direction until the distance between the first of the plurality of

triangles and the first of the plurality of features is greater than the safety margin around the first of the plurality of features.

8. The method in accordance with ~~any one of claims 2 to claim 7~~,
5 wherein the step of configuring further comprises, after considering and/or moving, the steps of:

considering if the local area of the first of the plurality of triangles is within the safety margin around the first of the plurality of features; and

10 when the local area of the first of the plurality of triangles is within the safety margin around the first of the plurality of features, moving each vertex of the first of the plurality of triangles along a direction until the distance between the local area around the first of the plurality of triangles is greater than the safety margin around the first of the plurality of features.

15 9. The method in accordance with claim ~~any one of claims 7 and 8~~, wherein the direction is along the normal of the triangle.

10. The method in accordance with any of the above claims, wherein the resection surface is a first of a plurality of resection surfaces.

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11. The method in accordance with any of claims 1 to 9, wherein the resection surface is a second of a plurality of resection surfaces, the second of the plurality of resection surfaces simulated based on a first of the plurality of resection surfaces.

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12. The method in accordance with any of claims 1 to 9, wherein the resection surface is a second of a plurality of resection surfaces, the second of the plurality of resection surfaces simulated based on a first of the plurality of resection surfaces simulated based on user modifications to the first of the plurality of resection surfaces.

13. The method in accordance with any of claims 10 to 13, wherein the plurality of resection surfaces include planar resection surfaces, swept resection surfaces and freeform resection surfaces.

14. The method in accordance with any of the above claims wherein the plurality of physical dimensions is obtained from radiographic imaging of the mass including two dimensional computed tomography images.

15. A computer readable storage medium having a computer program recorded therein, the program being executable by a computer apparatus to make the computer perform the procedure of surgical resection pre-operative planning of a mass, the mass comprising a plurality of internal features, the procedure comprising the steps of:

modelling the mass based on a plurality of physical dimensions;
determining a plurality of safety margins around a the plurality of internal features within the mass;
simulating a resection surface on the mass comprising a plurality of triangles;

optimizing local area and position of a first of the plurality of triangles on the resection surface based on a triangle-based algorithm and taking into account the plurality of safety margins;

updating the simulation of the resection surface; and

5 repeating the steps of optimizing and updating for each of the plurality of triangles on the resection surface.

16. The computer readable storage medium in accordance with claim 15, wherein the step of optimizing local area and position of a first of the plurality
10 of triangles on the resection surface based on a triangle-based algorithm comprises the steps of:

minimizing the local area around the first of the plurality of triangles;

and

configuring a distance between the first of the plurality of triangles and
15 a first of the plurality of features to be greater than a safety margin around the first of the plurality of features, the safety margin being one of the plurality of safety margins.

17. The computer readable storage medium in accordance with claim 16,
20 wherein the step of minimizing comprises:

modelling the minimization of the local area around the first of the plurality of triangles as a mathematical function;

applying a mathematical operation to the mathematical function; and

approximating the mathematical function using an approximation to
25 obtain a solution whereby the local area is minimized.

18. The computer readable storage medium in accordance with claim 17,
wherein the mathematical function is a partial differential equation:

wherein the mathematical operation includes a Laplacian operator
5 with edge swapping; and

wherein the approximation includes iterative approximation.

19. The computer readable storage medium in accordance with any one
of claims 15 to 18, wherein the step of configuring comprises:

10 considering if the first of the plurality of triangles is within the safety
margin around the first of the plurality of features; and

when the first of the plurality of triangles is within the safety margin
around the first of the plurality of features, moving the first of the plurality of
triangles along a direction until the distance between the first of the plurality of
15 triangles and the first of the plurality of features is greater than the safety
margin around the first of the plurality of features.

20. The computer readable storage medium in accordance with ~~any one~~
~~of claims 15 to 18~~ claim 19 wherein the step of configuring further comprises,

20 after considering and/or moving, the steps of:

considering if the local area of the first of the plurality of triangles is
within the safety margin around the first of the plurality of features;

when the local area of the first of the plurality of triangles is within the
safety margin around the first of the plurality of features, moving each vertex
25 of the first of the plurality of triangles along a direction until the distance

between the local area around the first of the plurality of triangles is greater than the safety margin around the first of the plurality of features;

wherein the resection surface is a second of a plurality of resection surfaces, the second of the plurality of resection surfaces simulated based on
5 a first of the plurality of resection surfaces; and

wherein the resection surface is a second of a plurality of resection surfaces, the second of the plurality of resection surfaces simulated based on a first of the plurality of resection surfaces simulated based on user modifications to the first of the plurality of resection surfaces.