WHAT IS CLAIMED:

1. A surgical computing device comprising memory comprising programmed instructions stored thereon and one or more processors coupled to the memory and configured to execute the stored programmed instructions to:

segment a central thalamus in an image of a human subject's brain to produce a segmented brain model;

model one or more fiber pathways in the segmented brain model;

determine a three-dimensional orientation of a dominant axis of a central lateral nucleus dorsal tegmental tract medial component (CL/DTTm) fiber bundle of the human subject based on the modelled one or more fiber pathways;

generate an initial model position and orientation in the segmented brain model for each of one or more electrodes based at least in part on the determined three-dimensional orientation of the dominant axis of the CL/DTTm fiber bundle of the human subject;

produce a stimulation map based on the modelled one or more fiber pathways and the generated initial model position and orientation in the segmented brain model for each of one or more electrodes; and

identify a position and orientation for a plurality of contacts of the one or more electrodes in the human subject's central thalamus fibers and electrical stimulus conditions for the positioned and oriented plurality of contacts of the one or more electrodes to selectively activate the central thalamus fibers of the human subject so that activation of a central lateral nucleus and medial dorsal tegmental tract fiber pathway in the human subject is maximized and activation of a centromedian-parafascicularis fiber pathway in the human subject is minimized based on the produced simulation map.

2. The surgical computing device of claim 1, wherein the one or more processors are further configured to execute the stored programmed instructions to:

register the segmented brain model to a brain model atlas to identify anatomical nuclei in the segmented brain model to identify the position and orientation for each of the one or more electrodes in the segmented brain model.

3. The surgical computing device of claim 1 or claim 2, wherein the registration is performed using symmetric normalization.

4. The surgical computing device of any one of claims 1 to 3, wherein the one or more processors are further configured to execute the stored programmed instructions to model the one or more fiber pathways in the segmented brain model based on diffusion tensor data.

5. A method for vector-based targeting of a human central thalamus to guide deep brain stimulation, the method comprising:

providing one or more electrodes each with a plurality of contacts;

determining a three-dimensional orientation of a dominant axis of a central lateral nucleus dorsal tegmental tract medial component (CL/DTTm) fiber bundle of the human subject;

positioning the plurality of contacts of the one or more electrodes in the human subject's central thalamus fibers in substantial alignment with the determined three-dimensional orientation of the dominant axis of the CL/DTTm fiber bundle; and

applying an electrical stimulus to the positioned plurality of contacts of the one or more electrodes to selectively activate the central thalamus fibers of the human subject, wherein the positioning and the applying are carried out to maximize activation of a central lateral nucleus and medial dorsal tegmental tract fiber pathway in the human subject and to minimize activation of a centromedian-parafascicularis fiber pathway in the human subject.

6. The method of claim 5, wherein 75% to 100% of the central thalamus fibers of the CL/DTTm fiber bundle are stimulated in carrying out the method.

7. The method of claim 5 or claim 6, wherein less than 25% of centromedian-parafascicularis fibers in the centromedian-parafascicularis fiber pathway in the central thalamus are stimulated in carrying out the method.

8. The method of any one of claims 5 to 7, further comprising:

determining one or more surgical trajectories that substantially avoid one or more lesions, wherein said positioning is further based on the determined surgical trajectories.

9. The method of any one of claims 5 to 8, wherein the applying an electrical stimulus is carried out using substantially in-phase or substantially out-of-phase stimulation on each of the one or more electrodes.

10. The method of any one of claims 5 to 9, wherein the applying an electric stimulus is ramped up or down at different rates of speed.

11. The method of any one of claims 5 to 10, wherein the applying an electrical stimulus is carried out using voltage wave trains having a monophasic or biphasic sine, square, spike, rectangular, triangular, or ramp configuration.

12. The method of any one of claims 5 to 11, wherein the applying an electrical stimulus is carried out using one or more stimulation programs that are capable of being interleaved in time.

13. The method of any one of claims 5 to 12, further comprising:

providing at least one sensor in communication with a brain of the human subject;

determining a state of neuronal activity in the human subject's brain based on data from the at least one sensor; and

adjusting the application of the electrical stimulus based on the determined state of neuronal activity in the human subject’s brain.

14. The method of any one of claims 5 to 13, further comprising:

imaging the human subject’s brain;

segmenting the central thalamus of the human subject’s imaged brain to produce a segmented brain model;

ascertaining one or more electrode positions, orientations, or electrical stimulation conditions within the segmented brain model that will maximize activation of a central lateral nucleus and medial dorsal tegmental tract fiber pathway in the human subject and minimize activation of a centromedian-parafascicularis fiber pathway in the human subject; and

producing a stimulation map based on the ascertaining, wherein the stimulation map is used to carry out the positioning and the applying.

15. A method for surgical planning involving vector-based targeting of a human central thalamus to guide deep brain stimulation, the method being implemented by one or more surgical computing devices and comprising:

segmenting the central thalamus in an image of a brain of the human subject to produce a segmented brain model;

modelling one or more fiber pathways in the segmented brain model;

determining a three-dimensional orientation of a dominant axis of a central lateral nucleus dorsal tegmental tract medial component (CL/DTTm) fiber bundle of the human subject based on the modelling;

generating initial model positions and orientations in the segmented brain model for one or more electrodes based at least in part on the determined three-dimensional orientation of the dominant axis of the CL/DTTm fiber bundle of the human subject;

producing a stimulation map based on the modelling and the generating; and

identifying a position and orientation for a plurality of contacts of the one or more electrodes in the human subject's central thalamus fibers and electrical stimulus conditions for the positioned and oriented plurality of contacts of the one or more electrodes to selectively activate the central thalamus fibers of the human subject so that activation of a central lateral nucleus and medial dorsal tegmental tract fiber pathway in the human subject is maximized and activation of a centromedian-parafascicularis fiber pathway in the human subject is minimized based on the produced simulation map.

16. The method of claim 15, wherein the generating the initial model positions and orientations within the segmented brain model further comprises:

registering the segmented brain model to a brain model atlas to identify anatomical nuclei in the segmented brain model.

17. The method of claim 15 or claim 16, wherein the registering is performed using symmetric normalization.

18. The method of any one of claims 15 to 17, wherein the modelling of the one or more fiber pathways in the segmented brain model is based on diffusion tensor data.

19. A non-transitory computer readable medium having stored thereon instructions for surgical planning involving vector-based targeting of a human central thalamus to guide deep brain stimulation comprising executable code that, when executed by one or more processors, causes the one or more processors to:

segment the central thalamus in an image of the human subject's brain to produce a segmented brain model;

model one or more fiber pathways in the segmented brain model;

determine a three-dimensional orientation of a dominant axis of a central lateral nucleus dorsal tegmental tract medial component (CL/DTTm) fiber bundle of the human subject based on the modelled one or more fiber pathways;

generate an initial model position and orientation in the segmented brain model for each of one or more electrodes based at least in part on the determined three-dimensional orientation of the dominant axis of the CL/DTTm fiber bundle of the human subject;

produce a stimulation map based on the modelled one or more fiber pathways and the generated initial model position and orientation in the segmented brain model for each of one or more electrodes; and

identify a position and orientation for a plurality of contacts of the one or more electrodes in the human subject's central thalamus fibers and electrical stimulus conditions for the positioned and oriented plurality of contacts of the one or more electrodes to selectively activate the central thalamus fibers of the human subject so that activation of a central lateral nucleus and medial dorsal tegmental tract fiber pathway in the human subject is maximized and activation of a centromedian-parafascicularis fiber pathway in the human subject is minimized based on the produced simulation map.

20. A system for vector-based targeting of a human central thalamus to guide deep brain stimulation, the system comprising:

the surgical computing device of any one of claims 1 to 4-35;

an imaging device operationally coupled to the surgical computing device;

one or more electrodes each comprising a plurality of contacts; and

an electrical stimulator coupled to the surgical computing device and the one or more electrodes to permit electrical activation of the one or more electrodes based on instructions from the surgical computing device.