

WHAT IS CLAIMED IS:

1. A medical device comprising:
a needle subassembly and a wire subassembly including a wire, wherein one of the
needle subassembly and the wire subassembly includes a permanent magnet element, and the
5 other of the needle subassembly and the wire subassembly includes a magnetizable feature to
permit measurement of relative motion of the wire subassembly and the needle subassembly.
2. The medical device of claim 1, wherein the wire subassembly comprises a guidewire.
- 10 3. The medical device according to claim 1, wherein the wire subassembly includes the
magnetizable feature and the needle subassembly includes the permanent magnet element, and
the magnetizable feature of the wire subassembly is selected from the group consisting of an
adhesive, the needle, a ferrule on the wire, and a spot weld on the wire.
- 15 4. The medical device according to claim 1, wherein the needle subassembly includes the
magnetizable feature and the wire subassembly includes the permanent magnet element, and
the magnetizable feature of the needle subassembly is selected from the group consisting of a
needle adhesive, the needle, a needle safety element, a notch, a needle ferrule, and a spot weld.
- 20 5. The medical device of claim 1, wherein the needle subassembly further comprises a
needle cannula having a hollow lumen and a guidewire inserted through the lumen, wherein
the guidewire includes one of a permanent magnet element and a magnetizable feature.
- 25 6. A system for determining relative position of a needle subassembly and wire
subassembly comprising:
a needle having a needle distal tip and a wire having a wire distal tip;
a permanent magnet element associated with one of the needle subassembly and wire
subassembly;
a magnetizable feature associated with the other of the needle subassembly and the wire
30 subassembly; and

magnetometers positioned with respect to the needle subassembly and the wire subassembly, the magnetometers configured to determine relative movement of the needle subassembly and wire subassembly.

- 5 7. The system of claim 6, wherein the permanent magnet or the magnetizable feature on a fixed location on the needle subassembly or wire subassembly provides a measurement datum to determine movement of the magnetizable feature and permanent magnet.
8. The system of claim 6, wherein the permanent magnet is on the wire subassembly and
10 the magnetizable feature is on the needle subassembly.
9. The system of claim 6, wherein the permanent magnet is on the needle subassembly and the magnetizable feature is on the wire subassembly.
- 15 10. The system of claim 6, wherein the magnetometers include three different magnetometers arranged in a three-dimensional grid array as part of an ultrasound system which can derive a three-dimensional correlation to obtain a distance from the grid array to the magnetizable feature or permanent magnet.
- 20 11. The system of claim 10, wherein the three-dimensional correlation is determined by a function $I = f(B_i \mu_r)$, where $i = x$ or y or z along three axes, x , y and z are distances in three planes, B is a known magnetic field produced by the permanent magnet or magnetizable feature, and μ_r is magnetic permeability.
- 25 12. The system of claim 10, wherein the correlation provides a distance in three planes to determine location of the needle distal tip.
13. The system of claim 11, wherein the correlation provides a distance in three planes to determine location of the wire distal tip.
- 30 14. The system of claim 6, wherein the wire subassembly comprises a guidewire or a stylet.

15. A method for determining a relative position of a wire tip and a needle cannula tip, the method comprising:

providing a needle subassembly including needle and a wire subassembly including a wire, the needle having a needle distal tip and the wire having a wire distal tip;

5 associating a permanent magnet element with one of the needle and the wire;

associating a magnetizable feature with the other of the needle and the wire;

obtaining a measured position of the permanent magnet;

obtaining a measured position of the magnetizable feature to obtain a calculated position of the needle distal tip and a calculated position of the wire distal tip; and

10 comparing the calculated position of the needle distal tip with the calculated position of the wire distal tip to determine the relative position of the needle distal tip and the wire distal tip.

16. The method of claim 15, wherein the wire includes the magnetizable feature and the needle includes the permanent magnet and the relative position of the needle distal tip and the wire distal tip indicates that the needle is properly seated on the wire.

17. The method of claim 15, wherein the needle subassembly includes the magnetizable feature and the wire subassembly includes the permanent magnet, and relative movement of the needle subassembly and wire subassembly is determined by a three-dimensional array of magnetometers positioned in proximity to at least one of the permanent magnet the magnetizable feature.

18. The method of claim 17, further comprising magnetizing the magnetizable feature by applying an external magnetic field to the magnetizable feature.

19. The method of claim 17, wherein the three-dimensional array of magnetometers is part of an ultrasound system, and the ultrasound system derives a three-dimensional correlation to obtain a distance from the array of magnetometers to the magnetizable feature or permanent magnet.

20. The method of claim 19, wherein the three-dimensional correlation is determined by the function $I = f(B_i \mu_r)$, where $i = x$ or y or z along three axes, x , y and z are distances in three

planes, B is a known magnetic field produced by the permanent magnet or magnetizable feature, and μ_r is magnetic permeability.

21. The method of claim 15, wherein the needle subassembly includes the permanent magnet and the wire subassembly includes the magnetizable feature, and relative movement of the needle subassembly and wire subassembly is determined by a three-dimensional array of magnetometers positioned in proximity to at least one of the permanent magnet the magnetizable feature.

22. The method of claim 21, further comprising magnetizing the magnetizable feature by applying an external magnetic field to the magnetizable feature.

23. The method of claim 21, wherein the three-dimensional array of magnetometers is part of an ultrasound system, and the ultrasound system derives a three-dimensional correlation to obtain a distance from the array of magnetometers to the magnetizable feature or permanent magnet.

24. The method of claim 23, wherein the three-dimensional correlation is determined by the function $I = f(B_i \mu_r)$, where $i = x$ or y or z along three axes, x , y and z are distances in three planes, B is a known magnetic field produced by the permanent magnet or magnetizable feature, and μ_r is magnetic permeability.

25. The method of claim 15, wherein the wire subassembly comprises a guidewire or a stylet.