

Claims:

1. An imaging device for acquiring a time series of in vivo images of a region of a subject's body, the imaging device including:
 - 5 at least one energy source;
 - at least one detector for detecting energy from the at least one energy source passing through the region of the subject's body located between the energy source and detector;
 - a controller configured to operate the at least one energy source and the
 - 10 at least one detector to acquire a time series of in vivo images of the region of the subject's body;
 - at least one sensor for monitoring a physiological parameter associated with the region of the subject's body to be imaged; and
 - at least one processor configured to determine timing of the image
 - 15 acquisition based at least on the monitored physiological parameter.
2. The imaging device according to claim 1, wherein the at least one sensor for monitoring the physiological parameter is configured to detect a physiological parameter associated with the subject's breathing.
3. The imaging device according to claim 2, wherein the processor is further
20 configured to:
 - analyse data from the at least one sensor for monitoring the physiological parameter to detect a breathing pattern of the subject and/or duration of the subject's breath; and
 - monitor the detected breathing pattern and/or duration of the subject's
 - 25 breath to determine if a repetitive breathing pattern is detected.
4. The imaging device according to claim 3, wherein if a repetitive breathing pattern is detected, the processor is further configured to:
 - analyse the repetitive breathing pattern to identify one or more
 - characteristics of a breathing cycle of the subject; and
 - 30 determine a trigger signal to commence image acquisition including at least a start time and/or end time based on the one or more identified characteristics of the breathing cycle.

5. The imaging device according to any one of the preceding claims, wherein the at least one sensor for monitoring the physiological parameter is positionable near and/or within the subject's mouth, and includes one or more of:
- a flowmeter for monitoring air flow changes near and/or within the subject's mouth;
 - a thermal sensor for monitoring temperature changes of the air near and/or within the subject's mouth; and
 - a gas sensor for monitoring gaseous changes in the air content near and/or within the subject's mouth.
6. The imaging device according to any one of the preceding claims, further including at least one sensor for monitoring movement of the subject's body located between the energy source and detector, wherein the processor is further configured to:
- determine timing of the image acquisition based also on the monitored movement of the subject's body.
7. The imaging device according to claim 6, wherein the processor is further configured to:
- process the data from the at least one sensor for monitoring movement to detect movement of the subject's body located between the energy source and detector;
 - monitor the detected movement to determine if the subject is in a substantially stationary position; and
 - determine a trigger signal to commence image acquisition including at least a start time if the subject is in the substantially stationary position.
8. The imaging device according to claim 6 or claim 7, wherein the at least one sensor for monitoring movement includes one or more of: a motion sensor, a resistive sensor, a weight sensor, a force sensor, and a pressure sensor.
9. The imaging device according to any one of the preceding claims, further including at least one sensor for detecting position and/or orientation of the subject's body located between the energy source and detector, wherein the processor is further configured to:

determine timing of the image acquisition based also on the detected position and/or orientation of the subject's body.

10. The imaging device according to claim 9, wherein the processor is further configured to:
- 5 determine an adjustment of the position and/or orientation of the subject's body to a desired location between the energy source and detector for acquiring the images of the region of the subject's body.
11. The imaging device according to claim 10, wherein the processor is further configured to:
- 10 estimate a position of the region of the subject's body to be imaged using prior-acquired data; and
- determine the desired location for acquiring the images based on the estimated position.
12. The imaging device according to claim 11, wherein the processor is further configured to receive the prior-acquired data including at least one of:
- 15 one or more prior-acquired images of the region of the subject's body;
- one or more physical characteristics of the subject selected from a group including: anatomical dimensions of the region and/or subject's body, height, and/or weight; and
- 20 one or more attributes of the subject selected from a group including: age, gender, mobility, ethnicity, disease status and/or medical history.
13. The imaging device according to any one of claims 10 to 12, further including:
- a support member for supporting the subject's body at a location between the energy source and detector; and
- 25 an actuator operable for adjusting the position and/or orientation of the support member.
14. The imaging device according to claim 13, wherein the controller is further configured to:
- 30 control the actuator to adjust the position and/or orientation of the support member to support the subject's body at the desired location for acquiring the images.

15. The imaging device according to claim 14, further including an output device,
and wherein the processor is further configured to:
output instructions, using the output device, for an operator and/or the
subject to adjust the subject's position and/or orientation to the desired location
for acquiring the images.
16. The imaging device according to any one of claims 9 to 15, wherein the at least
one sensor for detecting position and/or orientation includes one or more of: a
camera, a light sensor, a motion-based sensor, and a laser sensor.
17. The imaging device according to any one of the preceding claims, wherein the
region to be imaged includes at least part of a lung of the subject.
18. The imaging device according to any one of the preceding claims, configured
for use with one or more of x-ray imaging, ultrasound imaging, and magnetic
resonance imaging (MRI).
19. The imaging device according to any one of the preceding claims, including at
least three energy sources and at least three detectors for acquiring three time
series of in vivo images of the region of the subject's body, and wherein the
processor is further configured to:
reconstruct a three-dimensional motion field based on the three time
series of images acquired.
20. A method for acquiring a time series of in vivo images of a region of a subject's
body, the method including the steps of:
providing an imaging device including:
at least one energy source;
at least one detector for detecting energy from the at least one
energy source passing through the region of the subject's body located
between the energy source and detector; and
a controller configured to operate the at least one energy source
and the at least one detector to acquire a time series of in vivo images
of the region of the subject's body;
monitoring, using at least one sensor, a physiological parameter
associated with the region of the subject's body to be imaged;

determining, using at least one processor, timing of the image acquisition based at least on the monitored physiological parameter; and
operating the controller to acquire the time series of in vivo images of the region of the subject's body.

- 5 21. The method according to claim 20, further including the step of:
 detecting, using the at least one sensor for monitoring the physiological
 parameter, a physiological parameter associated with the subject's breathing.
22. The method according to claim 21, further including the steps of the processor:
 analysing data from the at least one sensor for monitoring the
10 physiological parameter to detect a breathing pattern of the subject and/or
 duration of the subject's breath; and
 monitoring the detected breathing pattern and/or duration of the
 subject's breath to determine if a repetitive breathing pattern is detected.
23. The method according to claim 22, wherein if a repetitive breathing pattern is
15 detected, the method further includes the steps of the processor:
 analysing the repetitive breathing pattern to identify one or more
 characteristics of a breathing cycle of the subject; and
 determining a trigger signal to commence image acquisition including at
 least a start time and/or end time based on the one or more identified
20 characteristics of the breathing cycle.
24. The method according to any one of claims 20 to 23, further including the step
 of:
 positioning the at least one sensor for monitoring the physiological
 parameter near and/or within the subject's mouth, and wherein the method
25 further includes one or more of the following steps:
 monitoring, using a flowmeter, air flow changes near and/or
 within the subject's mouth;
 monitoring, using a thermal sensor, temperature changes of the
 air near and/or within the subject's mouth; and
30 monitoring, using a gas sensor, gaseous changes in air content
 near and/or within the subject's mouth.

25. The method according to any one of claims 20 to 24, further including the step of:
monitoring, using at least one sensor, movement of the subject's body located between the energy source and detector, and wherein the method
5 further includes the step of the processor:
determining timing of the image acquisition based also on the monitored movement of the subject's body.
26. The method according to claim 25, further including the steps of the processor:
processing the data from the at least one sensor for monitoring
10 movement to detect movement of the subject's body located between the energy source and detector;
monitoring the detected movement to determine if the subject is in a substantially stationary position; and
determining a trigger signal to commence image acquisition including at
15 least a start time if the subject is in the substantially stationary position.
27. The method according to any one of claims 20 to 26, wherein the region to be imaged includes at least part of a lung of the subject.
28. The method according to any one of claims 20 to 27, wherein the imaging device is configured for use with one or more of x-ray imaging, ultrasound
20 imaging, and magnetic resonance imaging (MRI).
29. The method according to any one of claims 20 to 28, wherein the imaging device includes at least three energy sources and at least three detectors for acquiring three time series of in vivo images of the region of the subject's body, and wherein the processor is further configured to reconstruct a three-
25 dimensional motion field based on the three time series of images acquired.
30. An imaging device for acquiring a time series of in vivo images of a region of a subject's body, the imaging device including:
at least one energy source;
at least one detector for detecting energy from the at least one energy
30 source passing through the region of the subject's body located between the energy source and detector;

a controller configured to operate the at least one energy source and the at least one detector to acquire a time series of in vivo images of the region of the subject's body;

5 at least one sensor for detecting position and/or orientation of the subject's body located between the energy source and detector; and

 at least one processor configured to determine timing of the image acquisition based at least on the detected position and/or orientation of the subject's body.

31. A method for acquiring a time series of in vivo images of a region of a subject's
10 body, the method including the steps of:

 providing an imaging device including:

 at least one energy source;

 at least one detector for detecting energy from the at least one
15 energy source passing through the region of the subject's body located between the energy source and detector; and

 a controller configured to operate the at least one energy source and the at least one detector to acquire a time series of in vivo images of the region of the subject's body;

20 detecting, using at least one sensor, position and/or orientation of the subject's body located between the energy source and detector;

 determining, using at least one processor, timing of the image acquisition based at least on the detected position and/or orientation of the subject's body; and

25 operating the controller to acquire the time series of in vivo images of the region of the subject's body.