CLAIMS

1. A method, comprising:

receiving a digitized model of at least a portion of a composite structure having an inconsistency, wherein the digitized model includes a pre-calculated heating model that specifies a plurality of areas of the inconsistency for which corresponding different amounts of heating are applied to an uncured composite material that is applied to the inconsistency;

generating, from the digitized model, a design for a plurality of heating elements of varying density across the plurality of areas, wherein:

the design is configured to cause the plurality of heating elements in a first sub-area of a heat blanket system to generate a first amount of heat in a third area in the plurality of areas,

the design is further configured to cause the plurality of heating elements in a second sub-area of the heat blanket system to generate a second amount of heat in a fourth area in the plurality of areas, and

the first amount of heat is different than the second amount of heat; and

printing, according to the design, the plurality of heating elements on a blanket to manufacture the heat blanket system.

2. The method of claim 1, further comprising:

reworking the inconsistency by applying the uncured composite material to the inconsistency;

placing the heat blanket system on the uncured composite material after reworking; and

curing the uncured composite material by causing the plurality of heating elements to produce heat.

3. The method of any of claims 1 to 2, wherein the plurality of heating elements comprise resistive heating elements, and wherein the method further comprises:

connecting the resistive heating elements to an electrical power source; and

applying electrical power to the resistive heating elements.

4. The method of claim 1, further comprising:

printing a plurality of thermal sensors on the heat blanket system to sense a plurality of temperatures in the third area and the fourth area, wherein the heat blanket system further comprises the plurality of thermal sensors.

5. The method of claim 4, further comprising:

reworking the inconsistency by applying the uncured composite material to the inconsistency;

placing the heat blanket system on the inconsistency after reworking;

curing the uncured composite material by causing the plurality of heating elements to produce heat; and

monitoring, by the plurality of thermal sensors, a corresponding plurality of temperatures in the third area and the fourth area.

6. The method of any of claims 1 to 5, further comprising:

generating an alert if a first temperature in the third area exceeds a second temperature in a fourth area by more than a threshold temperature difference.

7. The method of claim 4 or 5, further comprising:

printing an alert device on the heat blanket system, the alert device in communication with the plurality of thermal sensors.

8. The method of any of claims 1 to 7, wherein printing is performed by a three dimensional printer programmed using the design.

9. A heat blanket system comprising:
    a blanket comprising a first sub-area and a second sub-area; and
    a plurality of heating elements printed on the blanket, wherein:
        first spacings between first ones of the plurality heating elements in the first sub-area varies relative to second spacings between second ones of the plurality of heating elements in the second sub-area,
        the first spacings and the second spacings vary according to a design,
        the design is configured for use on a uniquely defined rework area on a uniquely defined composite material object comprising a third area comprising a heat sink region and a fourth area comprising a non-heat sink region,
        the first sub-area is sized and dimensioned to be placed over the third area, and
        the second sub-area is sized and dimensioned to be placed over the fourth area.

10. The heat blanket system of claim 9, wherein the first spacings are less than the second spacings.

11. The heat blanket system of any of claims 9 to 10, further comprising:
    a power source connected to the plurality of heating elements.

12. The heat blanket system of claim 11, wherein
    the plurality of heating elements comprise resistive heating elements,
    the power source comprises a single source of electricity, and
    the power source is configured to apply an about constant current to the plurality of heating elements.

13. The heat blanket system of any of claims 9 to 12, wherein the blanket further comprises a plurality of perforations disposed through the blanket.

14. The heat blanket system of any of claims 9 to 13, further comprising:
a thermal sensor printed on the blanket.

15. The heat blanket system of claim 14, further comprising:
a wireless transmitter connected to the thermal sensor; and
a control circuit printed on the blanket, the control circuit configured to modify power delivered to the plurality of heating elements based on signals received by the wireless transmitter.

16. The heat blanket system of any of claims 9 to 15, wherein:
the blanket comprises paper or polyethylene terephthalate (PET), and
the plurality of heating elements comprise conductive or resistive inks.

17. The heat blanket system of claim 16, wherein the blanket further comprises:
a first dielectric layer disposed on a first side of the paper or PET, and
a second dielectric layer disposed on a second side of the paper or PET, opposite the first side.

18. A method of reworking an aircraft comprising a composite material having an area including an inconsistency, the method comprising:
preparing the aircraft for rework by preparing the composite material in the area of the inconsistency;
generating a digitized model of the area of the inconsistency, wherein the digitized model includes a heating model that specifies a plurality of sub-areas of the area of the inconsistency for which corresponding different amounts of heating are applied to an uncured composite material that is applied to the inconsistency;

generating, from the digitized model, a design for a plurality of heating elements of varying density across the plurality of sub-areas, wherein:

the design is configured to cause the plurality of heating elements to generate a first amount of heat in a first sub-area in the plurality of sub-areas,

the design is further configured to cause the plurality of heating elements to generate a second amount of heat in a second sub-area in the plurality of sub-areas, and

the first amount of heat is different than the second amount of heat;

printing, according to the design using a three dimensional printer, the plurality of heating elements on a blanket to manufacture a heat blanket system;

applying an uncured composite patch to the area of the inconsistency;

applying the heat blanket system to the uncured composite patch; and

curing the uncured composite patch by applying differential heating to the uncured composite patch using the heat blanket system.

19. The method of claim 18, further comprising:

printing a first thermal sensor and a second thermal sensor on the blanket as part of manufacturing the heat blanket system,

wherein the first thermal sensor is printed on the heat blanket system to measure a first temperature in the first sub-area, and

wherein the second thermal sensor is printed on the heat blanket system to measure a second temperature in the second sub-area.

20. The method of claim 19, further comprising:

measuring, during curing, the first temperature with the first thermal sensor;

measuring, during curing, the second temperature with the second thermal sensor; and

responsive a difference between the first temperature and the second temperature exceeding a threshold temperature difference, taking an

action to moderate the difference between the first temperature and the second temperature.