What is claimed:

1. A system for estimating a cardiac parameter of a patient based on a pre-determined model, the system comprising:

a blood pump comprising:

a rotor configured to be driven at one or more pump speeds; and

a sensor configured to measure a hemodynamic parameter; and

a controller comprising:

a driver configured to drive the rotor;

a display configured to display one or more parameters; and

a non-transitory computer readable storage medium storing:

a pre-determined model of a cardiac parameter, wherein the pre-determined model is formed by a neural network based on patient data for a first set of patients, wherein the patient data comprises measurements of at least one blood pump parameter for each patient in the first set of patients and measurements of at least one hemodynamic parameter for each patient in the first set of patients, wherein the neural network communicates over time in hidden states, and wherein the neural network iteratively develops the pre-determined model based on a plurality of activation functions; and

instructions that, when executed by one or more processors, cause the one or more processors to:

receive a hemodynamic parameter measurement for a second patient in a second set of patients from the sensor and record the hemodynamic parameter measurement;

receive a pump speed of the driven blood pump rotor from the driver and record the pump speed;

determine from the pre-determined model, based on the hemodynamic parameter measurement and the pump speed, an associated cardiac parameter; and

transmit the determined cardiac parameter to the display.

2. The system of claim 1, wherein the instructions further cause the one or more processors to determine a recommended change to the pump speed based on the determined cardiac parameter.

3. The system of claim 2, wherein the instructions further cause the one or more processors to transmit the recommended change to the pump speed to the display.

4. The system of claim 2, wherein the instructions further cause the one or more processors to make a change to the support provided by the blood pump based on the recommended change to the pump speed.

5. The system of claim 1, wherein the sensor is configured to measure at least one of aortic pressure, left ventricular end diastolic pressure, and capillary wedge pressure.

6. The system of claim 1, wherein each one of the measurements of the at least one hemodynamic parameter for the first set of patients or each one of the measurements of the at least one blood pump parameter for the first set of patients is obtained with a respective blood pump.

7. The system of claim 1, wherein each one of the measurements of the at least one hemodynamic parameter for the first set of patients is obtained with a respective sensing catheter separate from a respective blood pump.

8. The system of claim 1, wherein the pre-determined model is associated with patient information describing the first set of patients, and wherein the patient information comprises a diagnosis or a demographic for each patient in the first set of patients.

9. The system of claim 8, wherein the instructions further cause the one or more processors to determine whether the pre-determined model applies to the second patient based on the patient information associated with the pre-determined model.

10. The system of claim 1, wherein the neural network comprises a plurality of cells, and wherein a first cell of the plurality of cells accepts as inputs the measurements of the at

least one hemodynamic parameter and the measurements of the at least one blood pump parameter for the first set of patients at a first time point.

11. The system of claim 10, wherein the first cell transforms the measurements of the at least one hemodynamic parameter and the measurements of the at least one blood pump parameter before transmitting the transformed measurements of the at least one hemodynamic parameter and the transformed measurements of the at least one blood pump parameter to a second cell of the plurality of cells.

12. The system of claim 1, wherein the at least one hemodynamic parameter is an aortic pressure, and wherein the at least one blood pump parameter is a pump speed.

13. The system of claim 12, wherein the cardiac parameter is one of a cardiac output, a cardiac power output, a stroke volume, or a compliance.

14. The system of claim 1, wherein the neural network is a stacked bi-directional recurrent neural network.

15. The system of claim 1, wherein the neural network has three or more levels of cells stacked between an input row and an output row.

16. The system of claim 1, wherein the neural network is a fully recurrent neural network, an Elman network, a Hopfield network, an Echo state network, or a hierarchical neural network.

17. The system of claim 1, wherein the plurality of activation functions comprises a sigmoidal function.

18. The system of claim 1, wherein the plurality of activation functions comprises a hyperbolic tangent function.

19. The system of claim 1, wherein the plurality of activation functions comprises a sigmoidal function and a hyperbolic tangent function.