What is claimed is:

1. An anomaly detection method for rotating equipment, comprising:

collecting tri-axial acceleration raw data from sensors attached to the rotating equipment;

pre-processing the raw data through alignment and averaging over one rotation period of the rotating equipment to obtain pre-processed data;

extracting and combining features from the pre-processed data, the features including time-domain statistics features, frequency-domain characteristics features, and time-frequency domain features;

training a transformer-based autoencoder model by utilising the features to generate embeddings representing normal operational behaviour; and

detecting an anomaly by reconstructing input data with the transformer-based autoencoder model; a deviation between the input data and reconstructed data beyond a preset range indicates the anomaly.

2. The anomaly detection method for rotating equipment of claim 1, wherein the raw data comprises data in the Axial, Radial X, and Radial Y directions.

3. The anomaly detection method for rotating equipment of claim 2, the raw data is time-based signals.

4. The anomaly detection method for rotating equipment of claim 3, the raw data undergoes signal averaging based on the rotating equipment's rotational cycle.

5. The anomaly detection method for rotating equipment of claim 1, wherein the time-domain statistics features comprise mean and standard deviation.

6. The anomaly detection method for rotating equipment of claim 1, wherein the input data is real-time data.

7. The anomaly detection method for rotating equipment of claim 1, wherein the transformer-based autoencoder model learns normal behaviour patterns through attention mechanisms.

8. The anomaly detection method for rotating equipment of claim 1, wherein the rotating equipment comprises pumps and motors.

9. The anomaly detection method for rotating equipment of claim 8, wherein the sensors are tri-axial accelerometers mounted on the pumps or motors.

10. The anomaly detection method for rotating equipment of claim 1, wherein the rotating equipment is applied in sectors of manufacturing, water treatment, and power generation.

11. An anomaly detection system for rotating equipment, comprising
a processor; and

a memory with computer code instructions stored thereon, the memory operatively coupled to the processor such that, when executed by the processor, the computer code instructions cause the computer device to implement:

collect tri-axial acceleration raw data from sensors attached to the rotating equipment;

pre-process the raw data through alignment and averaging over one rotation period of the rotating equipment to obtain pre-processed data;

extract and combine features from the pre-processed data, the features including time-domain statistics features, frequency-domain characteristics features, and time-frequency domain features;

train a transformer-based autoencoder model by utilising the features to generate embeddings representing normal operational behaviour; and

detect an anomaly by reconstructing input data with the transformer-based autoencoder model; a deviation between the input data and reconstructed data beyond a preset range indicates the anomaly.

12. The anomaly detection system for rotating equipment of claim 11, wherein the raw data comprises data in the Axial, Radial X, and Radial Y directions.

13. The anomaly detection system for rotating equipment of claim 12, the raw data is time-based signals.

14. The anomaly detection system for rotating equipment of claim 13, the raw data undergoes signal averaging based on the rotating equipment’s rotational cycle.

15. The anomaly detection system for rotating equipment of claim 11, wherein the time-domain statistics features comprise mean and standard deviation.

16. The anomaly detection system for rotating equipment of claim 11, wherein the input data is real-time data.

17. The anomaly detection system for rotating equipment of claim 11, wherein the transformer-based autoencoder model learns normal behaviour patterns through attention mechanisms.

18. The anomaly detection system for rotating equipment of claim 11, wherein the rotating equipment comprises pumps and motors.

19. The anomaly detection system for rotating equipment of claim 18, wherein the sensors are tri-axial accelerometers mounted on the pumps or motors.

20. The anomaly detection system for rotating equipment of claim 11, wherein the rotating equipment is applied in sectors of manufacturing, water treatment, and power generation.