

We Claim:

1. A method for monitoring health and predicting failure of an electro-mechanical machine, the method comprising:

receiving, by a monitoring device, a plurality of operational parameters with respect to the electro-mechanical machine;

determining, by the monitoring device, a set of features and a set of events associated with the electro-mechanical machine based on the plurality of operational parameters;

detecting, by the monitoring device, one or more fault signatures associated the electro-mechanical machine based on at least one of the plurality of operational parameters, the set of features, or the set of events by referring to a plurality of pre-defined fault signatures, wherein the one or more fault signatures are indicative of a possible fault, and wherein the plurality of pre-defined fault signatures is provided in a fault signature library deployed on the monitoring device determining, by the monitoring device , at least one of a time to the possible failure and a remaining useful life of the electro-mechanical machine based on the plurality of operational parameters, the set of features, the set of events, and the one or more fault signatures by using a hybrid machine learning model, wherein the hybrid machine learning model is pre-trained multi-dimensional multi-variable machine learning model deployed on the monitoring device- and is based on domain knowledge with respect to the electro-mechanical machine; and

providing, by the monitoring device, at least one of the time to the possible failure and the remaining useful life of the electro-mechanical machine for rendering.

2. The method of claim 1, further comprising sending, by the monitoring device, field data to an analytics server communicatively coupled to the monitoring device, wherein the field data comprises the plurality of operational parameters, the set of features, the set of events, the one or more fault signatures, the time to the possible failure, and the remaining useful life.

3. The method of claim 2, further comprising:

receiving, by the monitoring device, an updated hybrid machine learning model and an updated fault signature library at a periodical interval from the analytics server, wherein the updated hybrid machine learning model and the updated fault signature library is generated by the analytics server based on the field data received from a plurality of monitoring devices, and wherein the updated hybrid machine learning model and the updated fault signature library is employed for monitoring of health and predicting failure of the electro-mechanical machine .

4. The method of claim 1, further comprising:

determining, by the monitoring device, a feature health index associated with each feature of the set of features;

computing, by the monitoring device, an overall health value of the electro-mechanical machine, based on the each of the feature health indexes associated with each feature of the set of features; and

providing, by the monitoring device, each of the feature health indexes and the overall health value of the electro-mechanical machine, for rendering.

5. The method of claim 4, further comprising rendering, via a user interface, the feature health index, the overall health value of the electro-mechanical machine, the time to the possible failure, or the remaining useful life in one of a plurality of predefined color zones for the feature health index, overall health value, the time to the possible failure, or the remaining useful life, respectively.

6. The method of claim 1, further comprising determining at least one of a mean time to repair (MTTR) for the electro-mechanical machine or a mean time between failures (MTBF) for the electro-mechanical machine, using hybrid machine learning model, wherein the MTTR and the MTBF are part of field data of the electro-mechanical machine.

7. The method of claim 1, wherein determining the time to the possible failure or the remaining useful life comprises:

comparing a value of a corresponding output of the hybrid machine learning model with a corresponding threshold value.

8. The method of claim 1, wherein the domain knowledge with respect to the electro-mechanical machine comprises at least one of a simulated model of the electromechanical machine, a known behavior of the electro-mechanical machine, a simulated behavior of the electro-mechanical machine, or a historical field behavior of the electro-mechanical machine installed in similar environment.

9. The method of claim 1, wherein the plurality of operational parameters comprise a load weight value, a temperature value, a vibration value, a pressure value, a current value, a rate of flow, and a revolution per minute (RPM) value.

10. The method of claim 1, wherein the set of features comprise at least overload count, overheat count, high vibrational count, high pressure count, high current count, high rotational count, or weighted vibration anomaly count.

11. The method of claim 1, wherein receiving the plurality of operational parameters related to the electro-mechanical machine further comprises:

receiving one or more signals representative of the plurality of parameters, wherein the one or more signals are obtained by the one or more sensors, and wherein the one or more signals are obtained in a frequency domain.

12. The method of claim 11, wherein obtaining the one or more signals in the frequency domain further comprises:

obtaining one or more signals in a time domain; and

generating one or more signals in the frequency domain, corresponding to the one or more signals obtained in the time domain, using spectral analysis.

13. A system for monitoring health and predicting failure of an electro-mechanical machine, the system comprising:

a monitoring device comprising at least one processor and a computer-readable medium storing instructions that, when executed by the at least one processor, cause the at least one processor to perform operations comprising:

receiving a plurality of operational parameters with respect to the electro-mechanical machine;

determining a set of features and a set of events associated with the electro-mechanical machine based on the plurality of operational parameters;

detecting one or more fault signatures associated the electro-mechanical machine based on at least one of the plurality of operational parameters, the set of features, or the set of events by referring to a plurality of pre-defined fault signatures, wherein the one or more fault signatures are indicative of a possible fault, and wherein the plurality of pre-defined fault signatures is provided in a fault signature library deployed on the monitoring device;

determining at least one of a time to the possible failure and a remaining useful life of the electro-mechanical machine based on the plurality of operational parameters, the set of features, the set of events, and the one or more fault signatures by using a hybrid machine learning model, wherein the hybrid machine learning model is pre-trained multi-dimensional multi-variable machine learning model deployed on the monitoring device and is based on domain knowledge with respect to the electro-mechanical machine; and

rendering at least one of the time to the possible failure and the remaining useful life of the electro-mechanical machine to a user via a user interface.

14. The system of claim 13, further comprising a one or more of sensors communicatively coupled to the monitoring device, the one or more sensors configured to acquire the plurality of operational parameters with respect to the electro-mechanical machine.

15. The system of claim 13, further comprising an analytics server communicatively coupled to the monitoring device, the analytics server configured to:

receive field data from the monitoring device and a plurality of other monitoring devices, wherein the field data comprises the plurality of operational parameters, the set of features, the set of events, the one or more fault signatures, the time to the possible failure, and the remaining useful life;

generate an updated hybrid machine learning model and an updated fault signature library based on field data received from the monitoring device and the plurality of other monitoring devices; and

send the updated hybrid machine learning model and the updated fault signature library to the monitoring device and the plurality of other monitoring devices.

16. The system of claim 13, further comprising a monitoring station communicatively coupled to the monitoring device, the monitoring station configured to render, via the user interface, the time to the possible failure or the remaining useful life in one of a plurality of predefined color zones for the time to the possible failure or the remaining useful life, respectively.