CLAIMS:

1. A monitoring system for detecting abnormalities in objects traveling along a track, the system comprising:

   a sensor provided adjacent the track, the sensor configured to detect interactions between the objects and the track;

   a data acquisition module (DAQ) coupled to the sensor, the DAQ configured to:

   receive signals generated by the sensor;

   normalize the received signals with baseline signals that represent normal operation of the objects along the track; and

   classify the objects as abnormal when periodic spikes are detected in the normalized signals.

2. The monitoring system according to claim 1 whereby the interactions between the objects and the track comprise vibrations generated when the objects interact with the track.

3. The monitoring system according to claim 1 wherein the classifying of the objects as abnormal by the DAQ comprises the DAQ being configured to:

   generate a threshold value based on the normalized signals, whereby periodic spikes that are less than the threshold value are removed from the DAQ.

4. The monitoring system according to claim 1 wherein the baseline signals comprise a baseline matrix R that is constructed by concatenating a baseline signal having a time-period P for N number of times.

5. The monitoring system according to claim 4 wherein before the DAQ normalizes the received signals with the baseline matrix R, the DAQ is configured to:

   divide the received signals into N number of blocks whereby each block comprises the time-period P, and whereby incomplete blocks are assigned values based on average values of the baseline matrix; and

   generate a signal matrix S by concatenating the divided received signals for the N number of times.

6. The monitoring system according to claim 5 wherein the normalizing the received signals with baseline signals comprises the DAQ being configured to:

   compute the energy difference between the signal matrix S and the baseline matrix R.

7. The monitoring system according to claim 3 wherein the generating of the threshold value based on the normalized signals comprises the DAQ being configured to:

integrate the normalized signal over a time window t wherein the threshold value is set based on the integral result, and wherein the time window t comprises at least two of the time-periods P.

8. The monitoring system according to claim 1 wherein the normalizing of the received signals with the baseline signals comprises the DAQ being configured to:

divide the received signals into N number of blocks whereby each block comprises a time-period P;

perform a Fast-Fourier Transform (FFT) analysis on each of the blocks of the received signals to convert the received signals in each block from a time-domain signal into a frequency-domain signal.

9. The monitoring system according to claim 1 wherein the sensor comprises an accelerometer and the DAQ comprises an accelerometer controller.

10. The monitoring system according to claim 1 wherein the sensor comprises a Fiber-Bragg-Grating (FBG) sensor and the DAQ comprises an FBG interrogator.

11. The monitoring system according to claim 1 wherein the sensor comprises a vibration or strain sensor, a proximity sensor and a module configured to acquire a windowed signal for individual rollers based on signals received from the vibration or strain sensor and the proximity sensor.

12. A method for detecting abnormalities in objects traveling along a track using a monitoring system comprising a sensor provided adjacent the track and a data acquisition module (DAQ) coupled to the sensor, the method comprising:

detecting, using the sensor, interactions between the objects and the track;

receiving, using the DAQ, signals generated by the sensor;

normalizing, using the DAQ, the received signals with baseline signals that represent normal operation of the objects along the track; and

classifying, using the DAQ, the objects as abnormal when periodic spikes are detected in the normalized signals.

13. The method according to claim 12 whereby the interactions between the objects and the track comprise vibrations generated when the objects interact with the track.

14. The method according to claim 12 wherein the step of classifying of the objects as abnormal by the DAQ comprises the steps of:

generating a threshold value based on the normalized signals, whereby periodic spikes that are less than the threshold value are removed from the DAQ.

15. The method according to claim 12 wherein the baseline signals comprise a baseline matrix R that is constructed by concatenating a baseline signal having a time-period P for N number of times.

16. The method according to claim 15 wherein before the step of normalizing the received signals with the baseline matrix R, the method comprises the step of:

dividing, using the DAQ, the received signals into N number of blocks whereby each block comprises the time-period P, and whereby incomplete blocks are assigned values based on average values of the baseline matrix; and

generating, using the DAQ, a signal matrix S by concatenating the divided received signals for the N number of times.

17. The method according to claim 16 wherein the step of normalizing the received signals with baseline signals comprises the step of:

computing the energy difference between the signal matrix S and the baseline matrix R.

18. The method according to claim 14 wherein the step of generating the threshold value based on the normalized signals comprises the step of:

integrating, using the DAQ, the normalized signal over a time window t wherein the threshold value is set based on the integral result, and wherein the time window t comprises at least two of the time-periods P.

19. The method according to claim 12 wherein the step of normalizing the received signals with the baseline signals comprises the step of:

dividing, using the DAQ, the received signals into N number of blocks whereby each block comprises a time-period P;

performing, using the DAQ, a Fast-Fourier Transform (FFT) analysis on each of the blocks of the received signals to convert the received signals in each block from a time-domain signal into a frequency-domain signal.

20. The method according to claim 12 whereby the sensor comprises a strain or vibration sensor, a proximity sensor and an acquiring module, the method comprising the step of:

acquiring, using the acquiring module, a windowed signal for individual rollers based on signals received from the strain or vibration sensor and the proximity sensor.