

Application of Artificial Intelligence in Marine Corrosion Prediction and Detection

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Corrosion

Corrosion is a natural and chemical process that leads to the degradation of metals, transforming them into undesirable substances such as oxides and sulfides.

Corrosion: A Costly Challenge

Billions in Losses

Corrosion costs the global economy trillions annually

Structural Damage

Weakens ships, pipelines and other marine infrastructure

Safety Risks

Can lead to catastrophic failures and environmental harm



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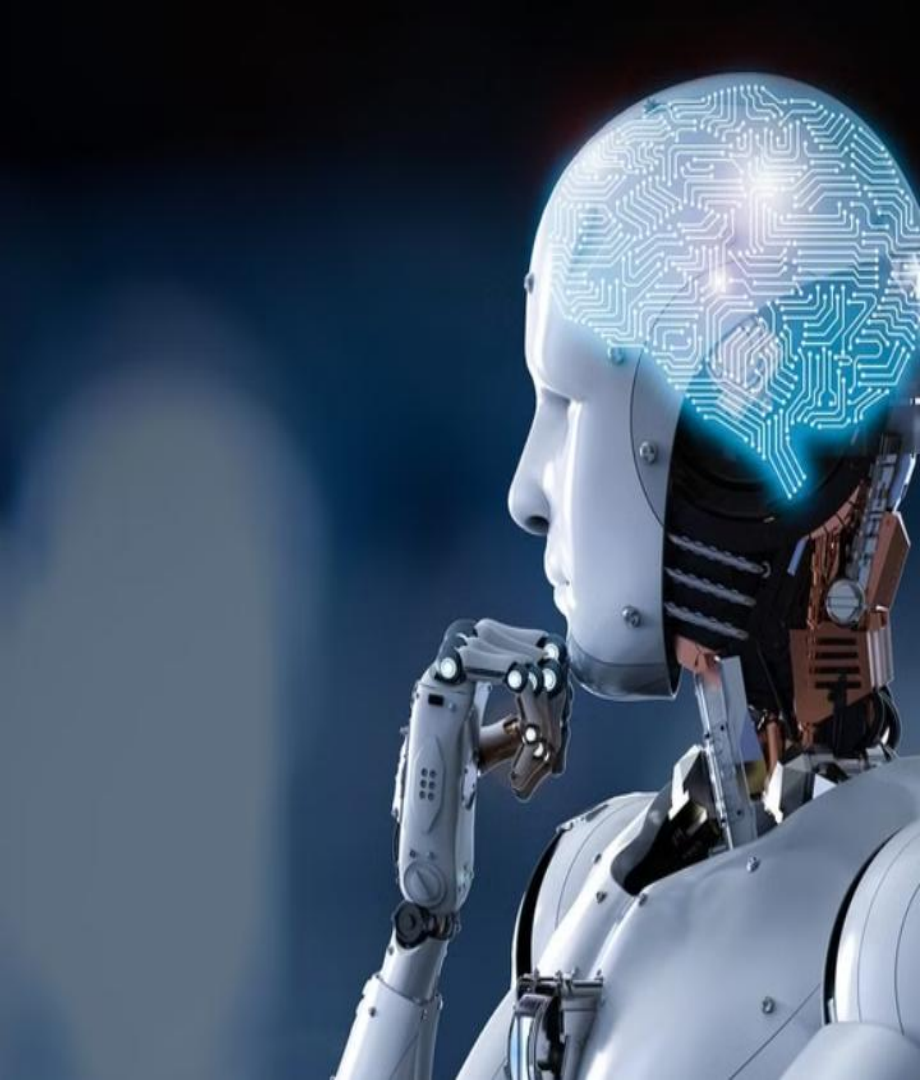
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Issues With Traditional Ways!!!!

1. Time-Consuming Processes
2. Inaccessibility of Areas
3. Labour-Intensive Inspections
4. Limited Predictive Capabilities



How Can AI Help ?

- Enhanced Efficiency
- Accessibility in Hard-to-Reach Areas
- Automated Inspections
- Predictive Maintenance

Artificial Intelligence

Pattern Recognition

Identifying patterns in complex data to detect and predict corrosion. Powerful for identifying hidden trends and anomalies.

Machine Learning (ML)

Training algorithms to learn from data and make predictions without being explicitly programmed. Enables adaptive, self-improving models.

Deep Learning (DL)

Advanced ML techniques utilizing artificial neural networks to uncover intricate patterns in large datasets for analysis.

AI Techniques for Corrosion

1

Pattern Recognition

Classifies corrosion types from sensor data

2

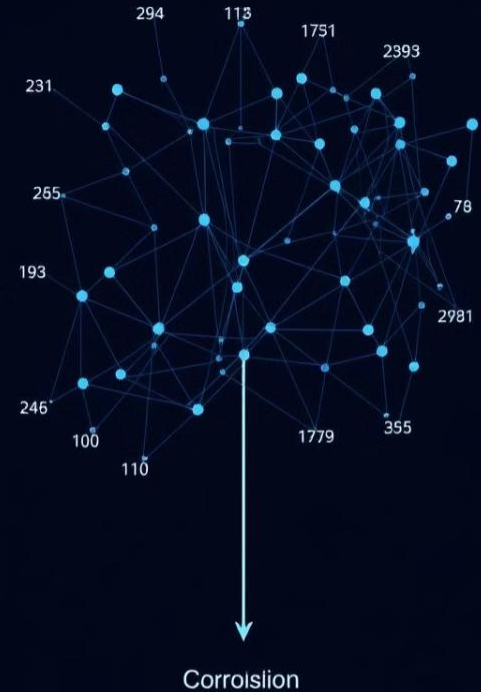
Machine Learning

Predicts corrosion progression from historical data

3

Deep Learning

Automates corrosion detection in images and videos



Corrosion Detection Approaches

There are 2 types of corrosion detection approaches

1. Predictive Maintenance Approach
2. computed vision and image processing technique



Predictive Maintenance Approach

Predictive maintenance is a way to find problems before they become serious. Imagine you have a car, and you notice a strange noise. Instead of waiting for the car to break down completely, you take it to a mechanic to check it out. This is similar to what PdM does for machines and materials. It looks for early signs of trouble so that maintenance can be done before a big problem occurs.



Types Of Predictive Maintenance Approaches

Knowledge-Based

Uses expert rules and historical data

Physics-Based

Simulates corrosion processes using physics and mathematical concepts

Data-Driven

Learns from sensor data with machine learning

Hybrid Approach

1

Physics + Data

Combine physics and machine learning

2

Sensors + AI

Integrate real-time monitoring with predictive models

3

Maintenance + Inspection

Optimise repair scheduling with corrosion detection



Computer Vision for Corrosion



Image Acquisition

Capture images and video of corroded surfaces

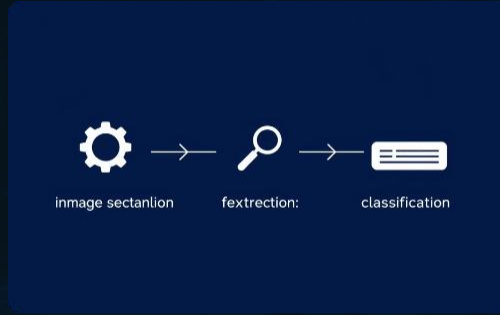


Image Processing

Enhance, filter and analyse visual data



Automated Detection

Use deep learning to classify and quantify results

Types Of Computer Vision Techniques



Infrared Thermography

Detects corrosion from infrared
Cameras



Texture Analysis

Detects corrosion by analysing
the texture of the surface



Non - Destructive Method

Monitors corrosion-induced
cracking and pitting



Challenges and Opportunities

1

Data Limitations

Lack of historical corrosion data for training

2

Model Complexity

Balancing accuracy and interpretability

3

Integration

Seamlessly embedding AI into operations

4

Future Potential

Transforming maintenance and inspection practices

Conclusion

Transformative Impact

AI revolutionising marine corrosion management

Ongoing Research

Continuous advancements in techniques and applications

Bright Future

Safer, more efficient and sustainable maritime operations



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For full references, please see the original publication.

