**Smart Rivers 2019 Conference**

**/ September 30 - October 3, 2019  
Cité Internationale / Centre de Congrès  
Lyon FRANCE /**

**Ref. author:**

**Thuong Van DANG – Department of ArGEnCo/ANAST**

University of Liege, Belgium

[thuongdv@tlu.edu.vn](mailto:antonella.frigerio@rse-web.it)

**Co-authors:**

**Pablo G. MORATO – Department of ArGEnCo/ANAST**

University of Liege, Belgium

pgmorato@uliege.be

**Quang Anh MAI – Department of ArGEnCo/ANAST**

University of Liege, Belgium

aq.mai@uliege.be

**Philippe RIGO – Department of ArGEnCo/ANAST**

University of Liege, Belgium

ph.rigo@uliege.be

**Keywords:**

Fatigue, Inspection, Miter gate, Dynamic Bayesian network, Cost

**Title:**

**Risk based inspection and maintenance planning of miter gates**

**Abstract:**

Navigation locks play a significant role in inland waterway infrastructures. They allow vessels to transfer from one water level to another. Because of its low cost, high transport capacity, fuel efficiency and environmental friendliness, it is expected that inland navigation transportation will grow and that locks will become larger and of more importance in the future in countries like Vietnam.

Miter gates are widely used in navigation locks thanks to its economical and aesthetic aspects. Due to variations of water levels during operation, miter gates are subjected to fatigue damage caused by cyclic loading. The nature of fatigue damage is complicated because fatigue cracks can develop from various unexpected initial defects coming from the manufacturing process. Inspection and repair of developed cracks are costly because the gate needs to be put out of service.

The risk-based approach for inspection and maintenance planning is based on pre-posterior decision analysis concerning the two basic decision rules about inspection and repair. This paper discusses the methods to update the failure probability of welded joints considering crack inspection data by using Dynamic Bayesian Network. This method is useful for effective computation deterioration modeling, and failure probabilities can be updated rapidly. Risk-based inspection planning combines the updated probabilities with specific costs of failure, inspection, repair and annual discounting rate in order to estimate the operation and maintenance costs, which is a substantial part of the total expected costs during the service life.

The methodology is then applied to a specific case where the operation, maintenance and failure costs of a miter gate are estimated for two sets of heuristic decision rules with respect to the time of inspection: *“inspections performed at regular time intervals*” and “*inspection performed when a certain annual probability failure threshold is reached*”. It is assumed that any crack size which is equal or larger than the detectable size (detected during inspection) is repaired. The result shows that the heuristic method based on an “*annual probability failure threshold”* leads to a lower operation, maintenance and failure cost for the specific case study.