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EPC method for delamination assessment of basalt FRP pipe: electrodes number effect

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Abstract. Delamination is the most common failure mode in layered composite materials. The author have found that the electrical potential change (EPC) technique using response surfaces method is very effective in assessment delamination in basalt fiber reinforced polymer (FRP) laminate composite pipe by using electrical capacitance sensor (ECS). In the present study, the effect of the electrodes number on the method is investigated using FEM analyses for delamination location/size detection by ANSYS and MATLAB, which are combined to simulate sensor characteristic. Three cases of electrodes number are analyzed here are eight, twelve and sixteen electrodes, afterwards, the delamination is introduced into between the three layers [0º/90º/0º]s laminates pipe, split into eight, twelve and sixteen scenarios for cases of eight, twelve and sixteen electrodes respectively. Response surfaces are adopted as a tool for solving inverse problems to estimate delamination location/size from the measured EPC of all segments between electrodes. As a result, it was revealed that the estimation performances of delamination location/size depends on the electrodes number. For ECS, the high number of electrodes is required to obtain high estimation performances of delamination location/size. The illustrated results are in excellent agreement with solutions available in the literature, thus validating the accuracy and reliability of the proposed technique.

Keywords: delamination monitoring; Electrical Capacitance Sensor (ECS); basalt FRP pipe; FEM; response surfaces method; least square error method

1. Introduction

Delamination is the most common damage in composite materials during manufacturing and subsequent operational effects such as impact loads, fatigue, etc. Since a delamination in a laminated composite is usually hidden between layers, it is very difficult to detect the delamination while the composite structure is in service, thus causing low reliability. To ensure the integrity and reliability operating composite components, an expert system for delamination monitoring for applications that the composite structures under service is required.

Non-destructive testing (NDT) methods have been found to be useful for in-situ evaluation of composites structures, where the structural integrity of laminate composite structures can be

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