Guided wave testing of thermoplastic composite ultrasonic welds produced with different welding travel

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1. Introduction

1.1. Context of data

The data refers to measurements on single-lap joints manufactured by ultrasonic welding (UW) of adherends made of thermoplastic composite material. Three different values of the UW process parameter called travel were used to manufacture three different batches of joints. The travel was selected such that one of the batches had welds with the maximum single-lap shear strength (reference specimens), and the other two had welds with characteristics typical of the welding stage during which the ED is molten and starts to flow.

The joints in the reference batch were obtained with a travel of 0.12 mm, while the joints in the other two batches were obtained with travels equal to 0.02 and 0.08 mm. Each batch was composed of 5 specimens. The purpose of the study was to understand how ultrasonic guided waves (GWs) interact with weld interfaces obtained with different UW travel.

The data in this dataset was collected in the Aerospace Structures and Materials Laboratory of the Delft University of Technology November 2015. It is made public both to act as supplementary data for the doctoral dissertation and publications, and to allow other researchers to use this data in their own work.

The research conducted for the PhD project of Pedro Ochôa was integrated in the Thermoplastic Affordable Primary Aircraft Structure 2 (TAPAS 2) project, financed by the Netherlands Enterprise Agency of the Ministry of Economic Affairs.

1.2. Structure of the dataset

The dataset contains the file group "Guided wave test data".

1.2.1. Guided wave test data

This file group contains raw ultrasonic signals from GW tests performed on thermoplastic composite (TpC) ultrasonic welds.

- Naming convention: `D_trval_Sp_FkHz.mat`
    - `D` = testing date
    - `val` = welding travel value
    - `Sp` = specimen number
    - `F` = GW excitation frequency
- File format: MATLAB formatted data (.mat)

2. Methodological information

2.1. Guided wave test data

The ultrasonic excitation was produced by an Agilent 33500 B arbitrary waveform generator and transmitted to the specimen by a rectangular 16 mm × 8 mm × 0.4 mm piezo-ceramic (PZT) transducer. This transducer was made of APC 850 material provided by American Piezo Ltd, and bonded to the composite adherend 60 mm away from the overlap, as shown Figure 2. Two Mistras WSα general purpose wideband sensors were used to sense the ultrasonic response 40 mm before and after the joint overlap, which was then acquired by a PicoScope 6402 A digital oscilloscope. The sensors were coupled to the specimens by Sonotech shear gel and small mechanical clamps. The full GW testing setup is shown in Figure 1.

The excitation signal was a sinusoidal tone-burst with a 10-cycle Hanning window amplitude modulation generated at 200 and 250 kHz.
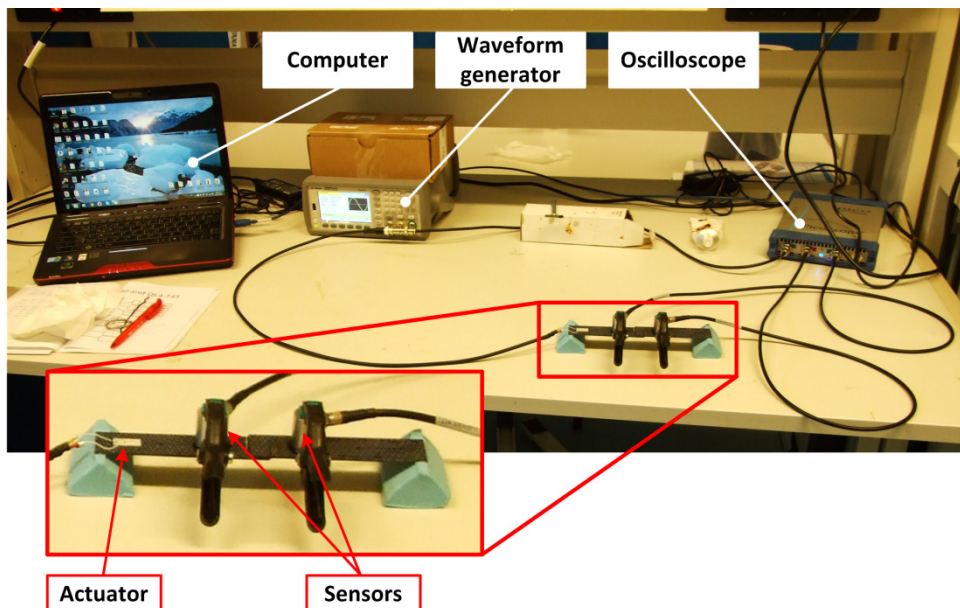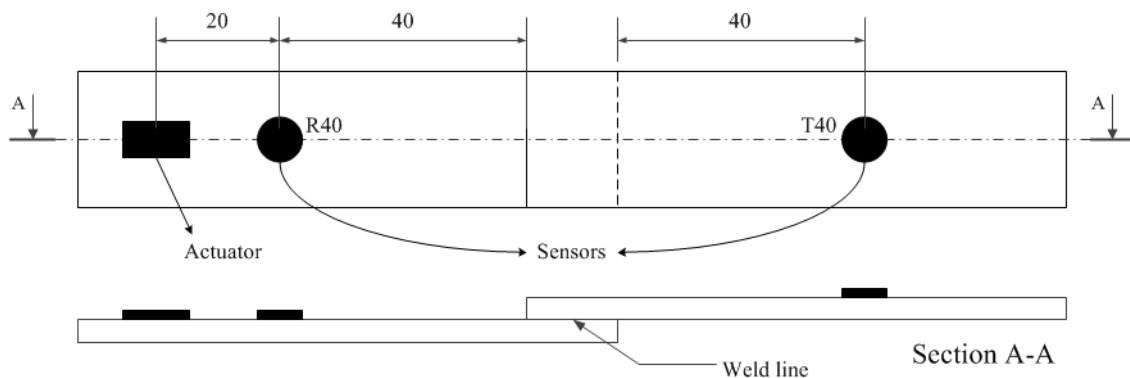

Figure 1. Setup used for the GW tests.

Figure 2. Diagram of the test specimen, with transducer positions (dimensions in mm). The waves reflected from the overlap were acquired at position R40, the wave transmitted across the overlap were acquired at position T40.

3. Data specific information

3.1. Guided wave test data

Each data file contains the excitation signal in variable **A,** the sensed signal from position T40 in variable **B**, and the sensed signal from position R40 in variable **C**. The size of all signals is identified

by variable **Length**, which contains the number of useful data points. The sampling interval is given in variable **Tinterval**. The reference start instant for the measurements is stored in variable **Tstart**.

- Units of measurement
  - o Signals: volt (V)
  - o Time: second (s)

4. Sharing and Access information

The dataset documentation and non-code data are covered by a
Creative Commons Attribution-NonCommercial (CC-BY-NC) licence.

The MATLAB code is covered by an MIT Licence which can be found in the same folder as this README file