6-4-2021

SDNET2021: Annotated NDE Dataset for Structural Defects

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READ ME FILE FOR SDNET2021: Annotated NDE dataset for Structural Defects.

The folders contain three types of non-destructive evaluation (NDE) data which are annotated using ground truth information collected from five in-service reinforced concrete bridge decks. The NDE data collected in this study are Impact Echo (IE), Ground Penetrating Radar (GPR), and Infrared Thermography (IRT). The dataset was annotated using three classes in accordance with bridge deck repair: **Class 1** No Delamination; **Class 2** Delamination (delamination above top bar mat), and **Class 3** Delamination (delamination below top bar mat).

Name of parent folder (Dataset) – Structural Defect Dataset 2021 (SDNET2021)

Name of Sub-folders- There are five (5) sub-folders with its contents described below:

- **1. Ground Truth**

This folder contains eleven (11) files: five (5) DWG cad files, and one (1) combined pdf file format. These files show the location of Class 2 and Class 3 delamination on the investigated bridge decks.

- **2. IE and GPR TEST POINTS**

This folder contains ten (10) dwg CAD files for GPR and IE signals showing the test points, regions, and locations. The IE and GPR are plotted separately on the same layouts for each bridge decks. 206 GPR files containing 663,102 signals and 1,936 IE test point signals were collected for the study and shown in their respective folders. For the GPR data, the raw signals are directly annotated while the IE signals are annotated on a separate Ms excel workbook automatically using MATLAB 2020b program software.

- **3. Impact Echo Data**

This folder contains two (2) sub-folders: Impact Echo Field Data and Impact Echo Annotated Data.

a) **01-Impact Echo Field Data:** This contains five (5) sub-folders.
The five (5) sub-folders contain the raw data of the IE points collected on site for each of the bridges. Each of the 5 sub-folders contains sub-folders which contains the regions of test points A, B, C, D as appropriate. These regions (10'x10') are plotted on the deck layout and shown in the report and in the 'IE and GPR TEST POINTS' folder mentioned above. The raw data was provided as raw data for referencing its annotation which has been provided in the next sub-folder.

b) **02-Impact Echo Annotated Data:** This folder contains a Ms. Excel workbook format with name *"ND Bridge_IE_ANNOTATION"*. The workbook contains Five (5) sheets, each sheet for each of the bridges. The columns of these sheets are Bridge, Date, File Number, FileName_LVM, Origin_X_Offset_ft, Origin_Y_Offset_ft, Origin, Local_Y_ft, Data Quality (Inspector) and sub-surface delamination (Delamination Class). This file must be read along with the raw files discussed in the field data above to identify the correct annotation of each of the IE signals. An excerpt of the IE annotated data is shown in the Figure 1.

			IMPACT ECHO ANNOTATION PARK RIVER SOUTH-BOUND							
Bridge	Date	File Number	File Name_LVM	Origin_X_Offset_ft	Origin_Y_Offset_ft	Origin	Local_X_ft	Local_Y_ft	Data Quality	Class Removal (Revised)
UND-PR-SB	7/9/2020	0	Metal.lvm	110	0	4A	0	0	GOOD	1
UND-PR-SB	7/9/2020	2	Metal_2.lvm	110	0	4A	1	0	GOOD	1
UND-PR-SB	7/9/2020	3	Metal_3.lvm	110	0	4A	2	0	GOOD	1
UND-PR-SB	7/9/2020	4	Metal_4.lvm	110	0	4A	3	0	GOOD	1
UND-PR-SB	7/9/2020	5	Metal_5.lvm	110	0	4A	4	0	GOOD	1
UND-PR-SB	7/9/2020	6	Metal_6.lvm	110	0	4A	5	0	GOOD	1
UND-PR-SB	7/9/2020	7	Metal_7.lvm	110	0	4A	6	0	GOOD	1
UND-PR-SB	7/9/2020	8	Metal_8.lvm	110	0	4A	7	0	GOOD	1
UND-PR-SB	7/9/2020	9	Metal_9.lvm	110	0	4A	8	0	GOOD	1
UND-PR-SB	7/9/2020	10	Metal_10.lvm	110	0	4A	9	0	GOOD	1
UND-PR-SB	7/9/2020	11	Metal_11.lvm	110	0	4A	10	0	GOOD	1
UND-PR-SB	7/9/2020	12	Metal_12.lvm	110	0	4A	0	1	GOOD	1
UND-PR-SB	7/9/2020	13	Metal_13.lvm	110	0	4A	1	1	GOOD	1
UND-PR-SB	7/9/2020	14	Metal_14.lvm	110	0	4A	2	1	GOOD	1
UND-PR-SB	7/9/2020	15	Metal_15.lvm	110	0	4A	3	1	GOOD	1
UND-PR-SB	7/9/2020	16	Metal_16.lvm	110	0	4A	4	1	GOOD	1
UND-PR-SB	7/9/2020	17	Metal_17.lvm	110	0	4A	5	1	GOOD	1
UND-PR-SB	7/9/2020	18	Metal_18.lvm	110	0	4A	6	1	GOOD	1
UND-PR-SB	7/9/2020	19	Metal_19.lvm	110	0	4A	7	1	GOOD	1
UND-PR-SB	7/9/2020	21	Metal_21.lvm	110	0	4A	8	1	GOOD	1
UND-PR-SB	7/9/2020	24	Metal_24.lvm	110	0	4A	9	1	GOOD	1
UND-PR-SB	7/9/2020	25	Metal_25.lvm	110	0	4A	10	1	GOOD	1
UND-PR-SB	7/9/2020	26	Metal_26.lvm	110	0	4A	0	2	GOOD	1
UND-PR-SB	7/9/2020	27	Metal_27.lvm	110	0	4A	1	2	GOOD	1
UND-PR-SB	7/9/2020	28	Metal_28.lvm	110	0	4A	2	2	GOOD	1
UND-PR-SB	7/9/2020	29	Metal_29.lvm	110	0	4A	3	2	GOOD	1
UND-PR-SB	7/9/2020	30	Metal_30.lvm	110	0	4A	4	2	GOOD	1
UND-PR-SB	7/9/2020	31	Metal_31.lvm	110	0	4A	5	2	GOOD	1
UND-PR-SB	7/9/2020	32	Metal_32.lvm	110	0	4A	6	2	GOOD	1
UND-PR-SB	7/9/2020	33	Metal_33.lvm	110	0	4A	7	2	GOOD	1
UND-PR-SB	7/9/2020	34	Metal_34.lvm	110	0	4A	8	2	GOOD	1

PARK RIVER MEDIAN | FOREST RIVER NORTH-BOUND | PARK RIVER NORTH-BOUND | **PARK RIVER SOUTH-BOUND** | FORES

Figure 1. IE Annotation workbook and annotation format

- **4. GPR data**

This folder contains five (5) sub-folders of annotated GPR Data for each investigated bridge deck. Each folder contains signal data collected for each bridge deck while each file contains several hundreds and thousands of rows and columns. For instance, Figure 2 is an excerpt of file 001 (GPR signal 01) for Park River median bridge containing 16,383 amplitudes and 512 rows of time increment. The (x,y) coordinates of the signal amplitudes are shown and can be referenced with the test points in 'IE and GPR TEST POINTS' folder 2. In addition, each amplitude signal is annotated according to the class of delamination.

Length of Pass (ft.)	364.737		Signals:	16,383
Distance Per signal pass	0.022263			
CLASSES OF REMOVAL	Class 1	Class 2	Class 3	
	1	2	3	

signal	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
X	0.022263	0.044526	0.066789	0.089053	0.111316	0.133579	0.155842	0.178105	0.200368	0.222631	0.244895	0.267158	0.289421	0.311684	0.333947	0.35621	0.378473	0.400736	0.423	0.445263	0.467526	0.489789	0.512052	0.534315	0.556578	0.578842	0.601105
Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
slass of removal	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Time_ns	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude	Amplitude
0	32765	32777	32745	32748	32770	32753	32766	32763	32761	32765	32759	32761	32763	32811	32765	32755	32761	32770	32757	32762	32778	32803	32764	32758	32769	32764	32767
0.0234375	32765	32777	32745	32748	32770	32753	32766	32763	32761	32765	32759	32761	32763	32811	32765	32755	32761	32770	32757	32762	32778	32803	32764	32758	32769	32764	32767
0.046875	32765	32777	32745	32748	32770	32753	32766	32763	32761	32765	32759	32761	32763	32811	32765	32755	32761	32770	32757	32762	32778	32803	32764	32758	32769	32764	32767
0.0703125	32775	32784	32738	32741	32770	32753	32764	32760	32759	32766	32754	32763	32763	32815	32763	32755	32761	32765	32755	32764	32779	32804	32762	32757	32767	32761	32766
0.09375	32784	32790	32732	32735	32769	32754	32763	32757	32759	32765	32750	32766	32763	32812	32761	32755	32761	32762	32759	32766	32779	32799	32760	32758	32766	32757	32763
0.1171875	32791	32793	32728	32731	32768	32757	32757	32754	32764	32749	32769	32764	32806	32758	32758	32763	32759	32764	32769	32778	32787	32757	32760	32764	32755	32759	
0.140625	32794	32791	32726	32731	32767	32762	32764	32753	32762	32764	32748	32772	32765	32797	32756	32760	32766	32758	32775	32771	32776	32772	32756	32763	32763	32753	32756
0.1640625	32794	32785	32725	32733	32766	32766	32765	32753	32764	32764	32748	32774	32766	32790	32754	32763	32769	32760	32785	32772	32771	32757	32754	32767	32763	32753	32754
0.1875	32790	32776	32726	32739	32765	32772	32766	32753	32764	32764	32748	32775	32769	32784	32753	32765	32773	32764	32792	32771	32766	32747	32752	32770	32765	32755	32756
0.2109375	32783	32767	32730	32746	32764	32777	32766	32754	32763	32765	32745	32775	32771	32779	32753	32767	32775	32768	32795	32771	32758	32743	32751	32772	32767	32756	32760
0.234375	32774	32759	32739	32752	32764	32781	32764	32754	32763	32767	32743	32773	32771	32774	32754	32770	32776	32775	32794	32769	32749	32747	32751	32772	32769	32758	32766
0.2578125	32764	32754	32748	32755	32764	32782	32762	32755	32762	32769	32743	32771	32771	32769	32755	32776	32776	32783	32783	32767	32742	32754	32753	32772	32772	32760	32773
0.28125	32755	32752	32757	32756	32764	32780	32760	32756	32763	32773	32746	32769	32770	32765	32755	32784	32776	32789	32772	32765	32737	32761	32754	32770	32773	32761	32775
0.3046875	32751	32751	32765	32756	32766	32774	32756	32756	32764	32752	32768	32768	32762	32756	32793	32774	32795	32759	32764	32737	32768	32757	32768	32775	32762	32782	
0.328125	32752	32750	32769	32754	32767	32766	32751	32757	32764	32776	32760	32767	32765	32764	32757	32800	32772	32798	32744	32764	32738	32767	32759	32766	32776	32761	32784
0.3515625	32758	32748	32769	32757	32768	32758	32745	32757	32762	32763	32763	32769	32758	32803	32770	32797	32728	32764	32742	32761	32761	32765	32777	32761	32784		
0.375	32767	32747	32766	32760	32769	32751	32738	32757	32762	32779	32773	32763	32763	32776	32759	32798	32768	32795	32710	32765	32744	32756	32762	32766	32778	32760	32781
0.3984375	32775	32748	32762	32767	32770	32745	32731	32756	32759	32780	32774	32761	32763	32783	32761	32787	32766	32791	32690	32765	32742	32747	32761	32766	32779	32759	32776
0.421875	32782	32750	32756	32775	32770	32743	32725	32756	32756	32781	32770	32758	32764	32788	32765	32773	32764	32787	32672	32765	32738	32742	32761	32766	32779	32758	32772
0.4453125	32785	32751	32750	32780	32770	32741	32721	32755	32754	32784	32763	32757	32765	32790	32768	32763	32782	32657	32764	32730	32738	32760	32766	32778	32758	32768	
0.46875	32785	32754	32745	32784	32770	32739	32720	32756	32752	32788	32757	32758	32766	32787	32771	32744	32763	32776	32654	32761	32723	32739	32759	32764	32775	32760	32766
0.4921875	32783	32755	32742	32787	32769	32735	32722	32757	32751	32790	32754	32760	32766	32780	32773	32734	32762	32766	32657	32758	32717	32744	32758	32762	32772	32761	32765
0.515625	32781	32756	32740	32786	32766	32731	32728	32759	32750	32793	32754	32763	32764	32771	32771	32726	32760	32759	32668	32755	32715	32750	32757	32760	32767	32762	32765
0.5390625	32779	32755	32738	32783	32762	32724	32736	32760	32749	32795	32756	32766	32767	32764	32767	32718	32758	32758	32684	32751	32714	32757	32755	32759	32762	32762	32765
0.5625	32775	32753	32735	32778	32757	32718	32744	32759	32748	32793	32757	32760	32757	32760	32759	32711	32755	32742	32704	32747	32715	32763	32751	32758	32758	32761	32764
0.5859375	32771	32753	32734	32771	32753	32713	32752	32757	32746	32787	32755	32753	32753	32757	32750	32704	32751	32734	32724	32745	32721	32771	32748	32756	32753	32758	32761
0.609375	32766	32752	32733	32761	32749	32710	32758	32754	32743	32778	32748	32743	32749	32758	32742	32699	32746	32724	32741	32743	32730	32776	32746	32753	32748	32754	32755

Figure 2.GPR Annotation for signal 01

- **5. Infrared Thermography data.**

   This contains five (5) sub-folders including IRT stitched maps for each bridge. Each folder contains two (2) files each for: 'Original images' and 'Annotated images. The 'original images' is a stitched map prior to annotation while the other folders named 'Annotated images' contains pixel annotated based on the class of delamination, 1, 2 or 3 depicted by distinct color codes; Class **1**-No Delamination – (deck's greyish color), Class **2** Delamination (the green component of RGB color space is 255) and Class **3** Delamination (the red component of the RGB color space is 255). In total, there are 5 each of original and annotated IRT images in the folder.