UNIVERSITY
OF TRENTO

DIPARTIMENTO DI INGEGNERIA E SCIENZA DELL'INFORMAZIONE

38050 Povo – Trento (Italy), Via Sommarive 14
http://www.disi.unitn.it

SVM-BASED CLASSIFICATION APPROACH FOR SYNTHETIC-IMPULSE MICROWAVE IMAGING – DATA FORMAT

F. Viani, M. Benedetti, M. Donelli, L. Lizzi, A. Cresp, I. Aliferis, C. Pichot, and A. Massa

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ELEctromagnetic DIAgnostics Lab.
Information and Communication Technology Dept.
University of Trento
Via Sommarive 14, 38050 Trento, ITALY
Phone +39 0461 882057 Fax +39 0461 882093
E-mail: andrea.massa@ing.unitn.it

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SVM-based Classification Approach for Synthetic-Impulse Microwave Imaging

Data Format

F. Viani[(1)], M. Benedetti[(1)], M. Donelli[(1)], L. Lizzi[(1)],
A. Cresp[(2)], I. Aliferis[(2)], C. Pichot[(2)], and A. Massa[(1)]

[(1)] Department of Information Engineering and Computer Science
ELEDIA Research Group
University of Trento, Via Sommarive 14, 38050 Trento - Italy
Tel. +39 0461 882057, Fax. +39 0461 882093
E-mail: *andrea.massa@ing.unitn.it*

[(2)] Laboratoire d'Electronique, Antennes et Télécommunications (*LEAT*)
Université de Nice-Sophia Antipolis
250 rue Albert Einstein, 06560 Valbonne
Tél: +33 (0)4 92 94 28 02, Fax: +33 (0)4 92 94 28 12
E-mail: *christian.pichot@unice.fr*

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1 Introduction

The design of an ultra-wideband (UWB) surface penetrating radar requires a good understanding of the medium properties and of the electromagnetic propagation in ground-penetrating applications, which can be transposed in the knowledge of the environment contribution added up to the transmitted signal. In order to remove the contribution of the environment, the data collected with the SIMIS radar are differential measurements [1]. The overall concept of this technique is to determine a reference measurement, of the environment only, that can be removed by subtraction to enhance the interactions of the objects and calculate the scattered field coming from the targets only. The measurement can be performed either in the frequency or the time domain which mostly will provide the same information. In this configuration the measurements are made in the frequency domain and consequently time domain signals are obtained by an inverse fast fourier transform [2].

2 Acquired Data Format

In the frequency domain, each frequency component is sent and measured over a narrow bandwidth with a constant frequency step of $15\,MHz$ from $f_{min} = 2\,GHz$ to $f_{max} = 8.0\,GHz$ (for a total number of frequencies $F_{tot} = 401$). For each step, the adopted vector network analyzer (VNA HP8720B) collects in a text file ready to be postprocessed the real and imaginary parts of all the reflection $S_{mm}(f)$, $m = 1, ..., M$ and transmission $S_{nm}(f)$, $n = 1, ..., N$; $m = 1, ..., M$; $n \neq m$ parameters, where N and M are the number of receivers and transmitters, respectively. Also a Rohde & Schwarz VNA is available to collect the same data, the main differences consist in a slightly wider frequency bandwidth ($f_{min} = 1.5\,GHz$ and $f_{max} = 8.0\,GHz$) and a higher number of total frequency points $F_{tot} = 2001$. The whole frequency sweep of a measurement is finally stored in a three-dimensional structure as shown in Fig. 1. Every gray plane represents all the combinations between the m-th transmitter and n-th receiver (in this configuration $M = N$) for the data capture of all the S-parameters, while the pink pattern represents the frequency sweep of one S-parameter required by the inverse fourier transform procedure to obtain the UWB time-domain signal. As it can be seen, on the diagonal of each gray plane are stored all the reflection parameters $S_{mm}(f)$; $m = 1, ..., M$. Alternatively, when an extra antenna is adopted as transmitter and the array elements act as receivers, only the transmission parameters $S_{n1}(f)$; $n = 1, ..., N$ are measured and stored as in Tab. I. In this particular configuration, the transmitter index is fixed to $m = 1$ while the receiver index $n = 1, ..., N$ scans all the array elements.

References

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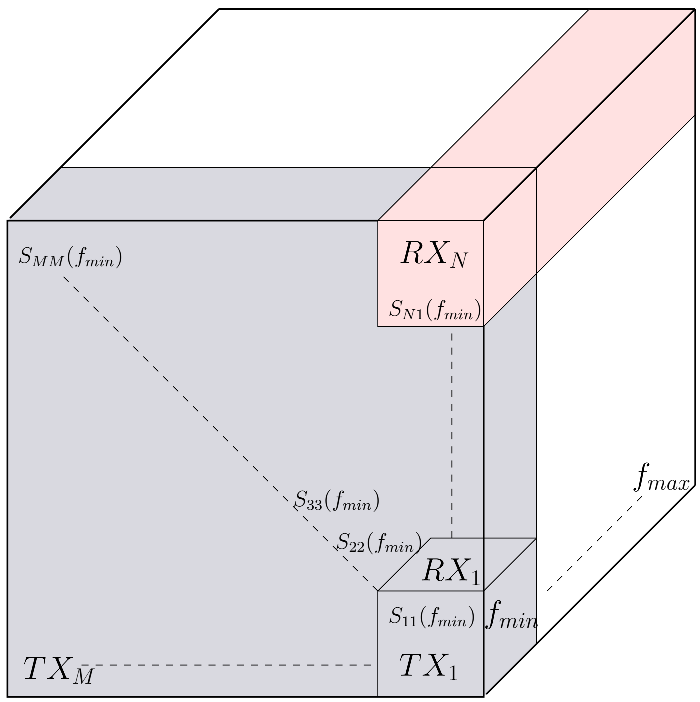

Fig. 1 - *SIMIS standard configuration* - frequency-domain data format.

f	$n=1$	$n=2$	$\cdots$	$n=N$
f_{min}	$\Re\left(S_{11}(f_{min})\right), \Im\left(S_{11}(f_{min})\right)$	$\Re\left(S_{21}(f_{min})\right), \Im\left(S_{21}(f_{min})\right)$	$\cdots$	$\Re\left(S_{N1}(f_{min})\right), \Im\left(S_{N1}(f_{min})\right)$
$\vdots$	$\vdots$	$\vdots$		$\vdots$
f_{max}	$\Re\left(S_{11}(f_{max})\right), \Im\left(S_{11}(f_{max})\right)$	$\Re\left(S_{21}(f_{max})\right), \Im\left(S_{21}(f_{max})\right)$	$\cdots$	$\Re\left(S_{N1}(f_{max})\right), \Im\left(S_{N1}(f_{max})\right)$

Tab. I - *SIMIS extra configuration* - Frequency-domain data format.