

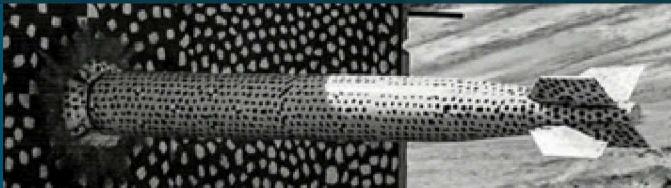


Geophysical Monitoring System (GMS)

Using the NDC Forum to Track & Resolve Issues with the “IDC Processing of SHI Data” Document



SAND2020-3364PE



PRESENTED BY

Chris Young

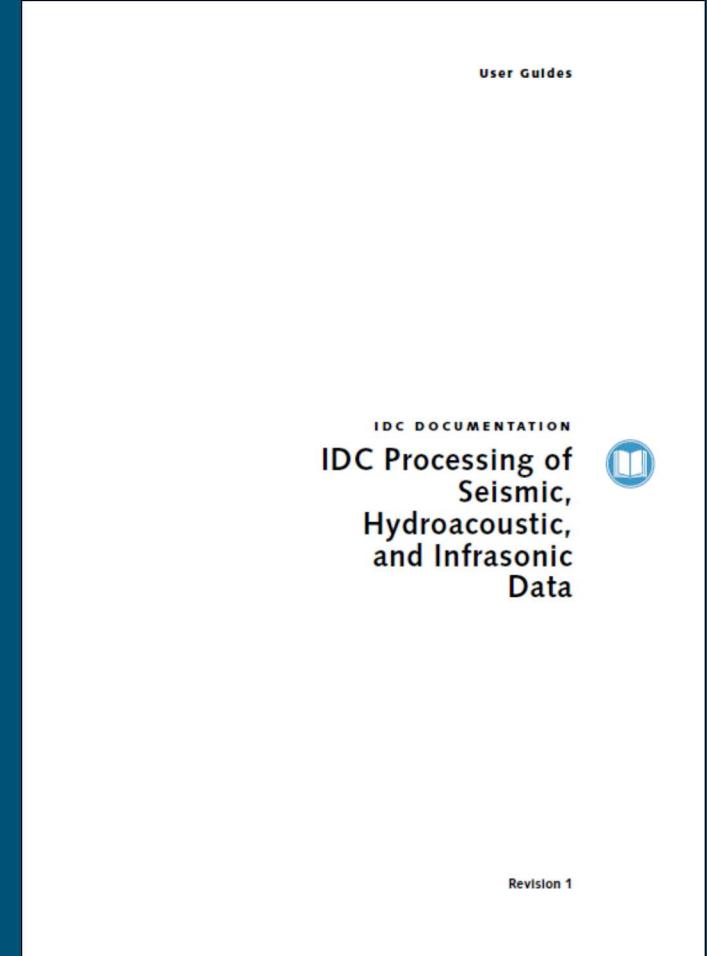


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What is This Document & Why Is It Important?

- *This document describes comprehensively and in detail the processing of SHI data by the IDC.*
- *Though the systems have diverged, there is still substantial algorithmic overlap between the USNDC and the IDC.*
- *This is usually our starting point for researching scientific algorithms that will be implemented in the GMS.*
- *The most recent version is from 2002, though most content is from the original version in 1999.*
- *Key assumption: document content = code content.*
- *When this is not true, significantly more SME effort may be required.*



Issues With The Document

Errors

- *Creating this document was a huge undertaking*
- *Many algorithms are complex and highly specialized; some mistakes were made in text and/or equations (only experts reading carefully would be likely to notice)*

Omissions

- *There had to be choices made about what level of detail to include*
- *Some things were left out, particularly specific details about processing (e.g., specific filters applied for a data processing task)*

New Algorithms

- *New calculations have been added to IDC system, some major (e.g., PMCC processing of infrasound)*
- *Few (any?) of these have been added to the document*

Efforts To Track Issues With The Document

Geophysical Monitoring System (GMS) System Development

- *To modernize, minimize re-use of existing code → recode all the algorithms.*
- *Coding algorithms means understanding them completely (every equation) → if there are mistakes, we find them.*
- *Maybe the most comprehensive, detailed review of the document to date??*

WGB Waveform Experts Group (WEG)

- *Chairman has been collecting issues from users and PTS experts over many years.*
- *Many of these seem to be about omissions related to details of processing.*

Collaboration Opportunity

Goals

- *Note issues with the document (all)*
- *Fix document (IDC staff?)*

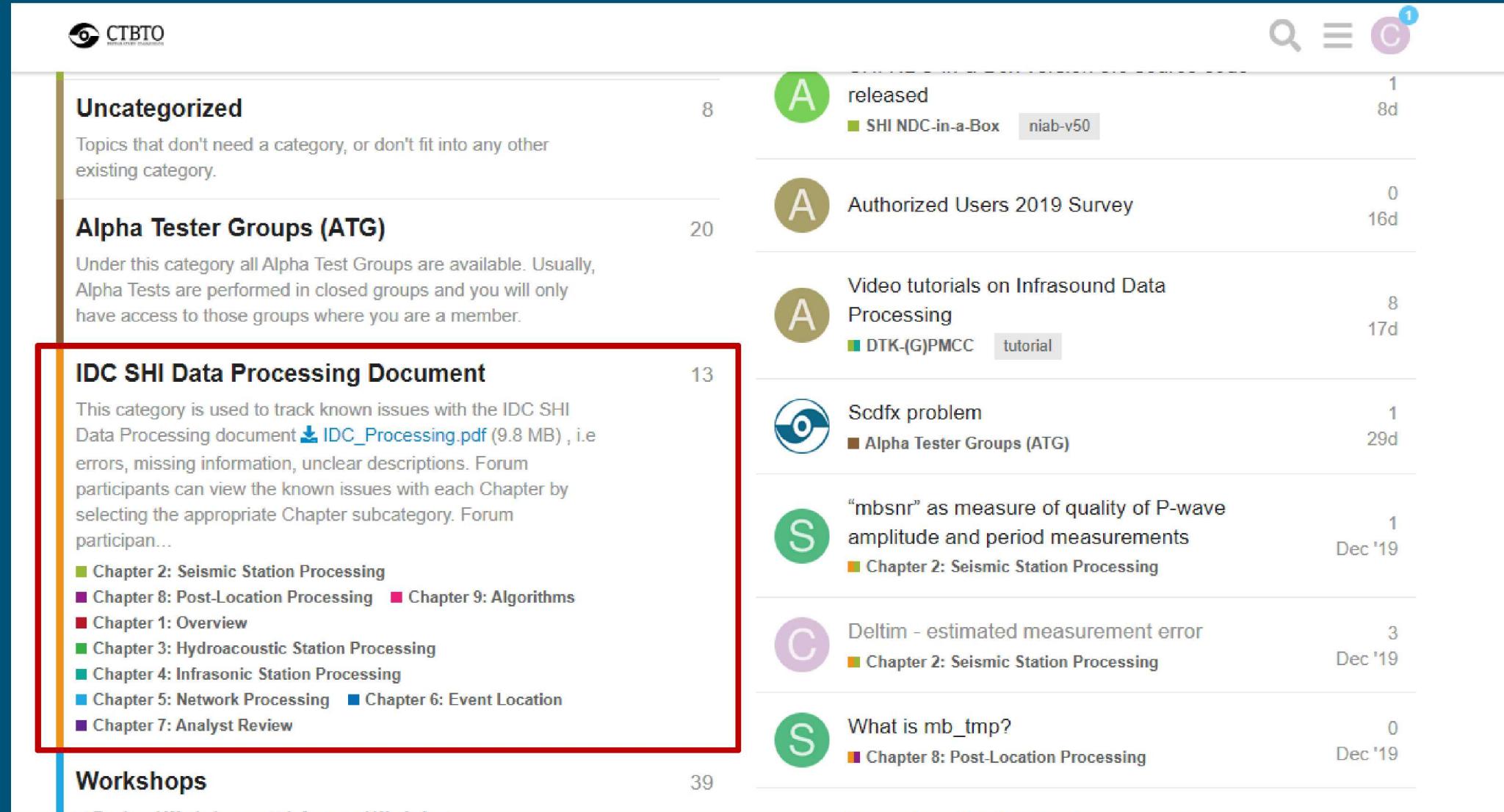
GMS can benefit from NDC member states knowledge, and IDC can benefit from GMS development

- *How do we facilitate this?*
- *Need a means to make sharing of information easy*
- *Needs to be a good fit for a global set of users (domain experts)*
- *Should be self-guided (i.e. automated, requiring little if any supervision)*
- *Very limited resources available to set up (people, time, \$)*

Solution: Use NDC Forum

- *Document is a “Topic”*
- *Chapters are “Sub-Topics”*

NDC Forum Topic



An Example Issue Entry & Discussion

Original issue entry
(author noted),
follows templated
format.

The screenshot shows a digital issue tracking system interface. On the left, a grey box contains the text: "Original issue entry (author noted), follows templated format." An orange arrow points from this box to the main content area. The main content area displays an issue entry titled "Error in FK calculation equation". The entry is attributed to "C.YOUNG" and was created on "Nov '19". The issue description includes a brief description, section/page information, and a longer description with a note about the error being in the equation, not the code. The status is "Submitted". A proposed solution is also provided. The reply section shows a reply from "SARAGIOTIS" with an orange arrow pointing to it. The reply discusses the numerator in the equation and provides a detailed explanation. Both entries have a "Solution" checkbox, a heart icon, a link icon, a bookmark icon, and a "Reply" button.

Error in FK calculation equation

IDC SHI Data Processing Document Chapter 9: Algorithms

C.YOUNG Nov '19

1. Brief Description: Error in FK calculation equation

2. Section/Page: Frequency-Wavenumber Analysis, page 225, Equation 141.

3. Status: Submitted

4. Longer Description: The $F_i(f)$ term in the numerator should be $X_i(f)$; i.e. the full complex Fourier transform of the i th element, not just the amplitude. It is necessary to include the phase information to combine with the phase information from the wavenumber transforms to get the proper interference of the signal from the different elements.
NOTE: the error is in the equation in the document, not in the implemented code. The IDC software is coded correctly.

5. Proposed Solution: In the numerator, replace $F_i(f)$ with $X_i(f)$.

Nov 2019
1 / 4
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Nov 2019

SARAGIOTIS Nov '19

I agree that the $F_i(f)$ in the numerator should be changed in equation 141 to $X_i(f)$.
The numerator in this equation is the energy of the beam (within a scaling constant) in the frequency domain (due to Parseval's theorem), therefore the summands of the inner sum should be the Fourier transforms of the shifted waveforms (channels of the array). The FT of each of the shifted signals is the FT of the non-shifted signal (that is $X_i(f)$) multiplied by the exponential (that makes for the shift).

Solution