

Integrating Judgment and Technical Data Analysis

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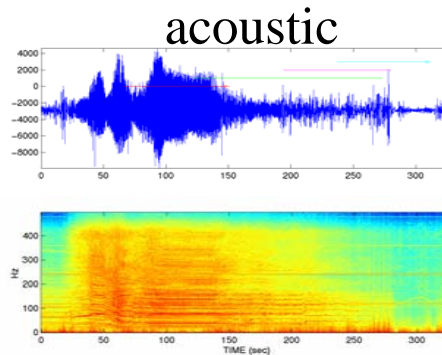
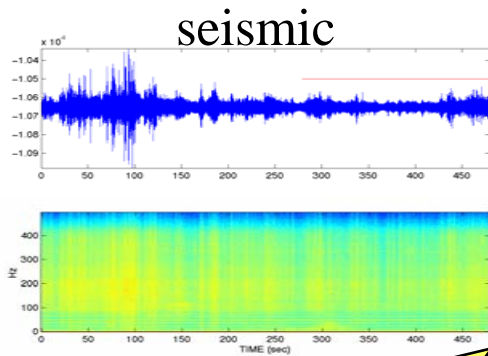
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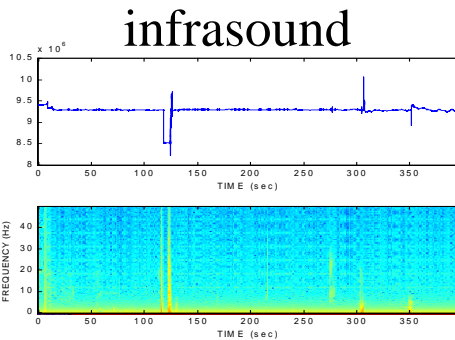
Problem

- Interpreting sensor returns requires extensive subjective judgment, even when comparing sensor readings to fixed signatures.
- Research in expert judgment and experience indicate that such judgments are subject to predictable judgment biases, such as
 - Law of small numbers (drawing conclusions from too little data)
 - Confirmation bias
 - Overconfidence

Background



Technical
Data
Analysis



processing

SAM Transporter Erector Launcher?



Is this the right inference?

How sure? (Now imagine a busy street!)



Judgment Here!!

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Objective

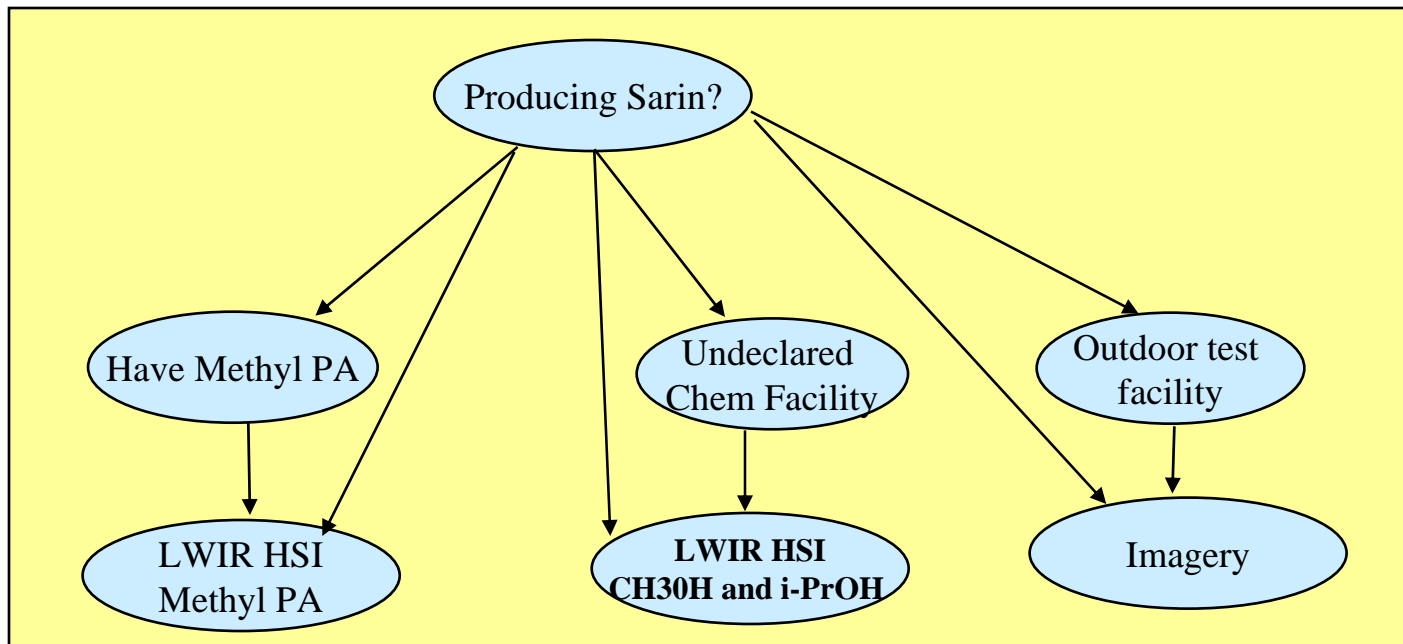
- **Enhance technical data analysis (TDA) by providing a structured analysis method that integrates judgment with technical considerations**

Activities

- **Adapt *Causal Judgment Analysis (CJA)* approach (elicit causal judgments from analysts/experts then derive implications of evidence)**
- **Develop analysis templates for different types of TDA problems**
- **Apply analysis templates to diverse government-selected problems**
- **Assess impact on ongoing analyses and performance on problems with ground truth (e.g., collection experiments)**

Highlight

Core complexity defines causal structure



**Typical causal structure when core complexity is “denial.”
Foreign actor will directly manipulate timing of indicators and
hide evidence.**

Highlight

Judgments needed to assess manipulation of indicators and evidence

Microsoft Excel - Possible evidence Hypo-Sarin-v3.xls

		H1: HC is producing Sarin Nerve Gas, which they are trying to hide.			H2: HC is developing capability to produce Sarin Nerve Gas, with intent to secretly produce it.	
Sensor Allocated	Indicator	Likelihood of Indicator?	If indicator true, what is likelihood of a "true detect"?	If indicator false, what is likelihood of a "false detect"?	Estimate the likelihood that this event would occur?	Assume that evidence occurred
Standoff LWIR hyperspectral sensor	Produce Sarin	definite yes	50/50	not relevant	definite no	not relevant
Close In GC-MS sensor	Produce Sarin	definite yes	50/50	not relevant	definite no	not relevant
Standoff LWIR hyperspectral sensor	Have Methyl-PA	very likely	50/50	very unlikely	very likely	50/50
Standoff LWIR to detect CH3OH and iPrOH	Undeclared chemical production facility.	very likely	very likely	50/50	very likely	somewhat likely
SIGINT	Have production facility with unique-to-CW equipment (e.g., glass-lined reactors)	definite yes	somewhat unlikely	not relevant	definite yes	somewhat likely
Open Sources, official announcements	Produce legitimate products using uncommon dual-use feed stocks (e.g., Pesticide that uses Methyl-PA)	very unlikely	somewhat likely	very unlikely	very unlikely	somewhat likely
Stellite imagery.	Outdoor test facility (e.g., tower encircled by regular grid)	somewhat likely	very likely	very unlikely	50/50	very likely
Open sources, interviews with	Foreign contractors are removed from multiple dual facilities	somewhat likely	definite yes	somewhat unlikely	very unlikely	definite yes

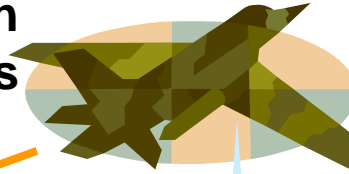
Causal structure defines analysis template that steps analyst through input judgments and analysis process

Impacts

- **Better technical data analysis via structured approach to integrating judgments of analysts and domain experts into analysis process**
- **Extensible to a diversity of analysis problems, especially all-source analyses**

Future Plans: Refine and Test

collection experiments



Sensor Allocated		Indicator	Likelihood of Indicator?	If indicator true, what is likelihood of a "true detect"?	If indicator false, what is likelihood of a "false detect"?	Estimate the likelihood that this <u>event</u> would occur?	Assume t
Standoff LWR hyperspectral sensor	Produce Sarin	definite yes	50/50	not relevant	definite no	not rel	
Close In GC-MS sensor	Produce Sarin	definite yes	50/50	relevant	definite no	not rel	
Standoff LWR hyperspectral sensor	Have Methyl-PA	very likely	50/50	very unlikely	very likely	50/	
Standoff LWR to detect CIGR and P/OH	Undeclared chemical production facility	very likely	very likely	50/50	very likely	somewh	
SIGINT	Have production facility with unique to CW equipment (e.g. glass lined reactor)	definite yes	somewhat unlikely	not relevant	definite yes	somewha	
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Open sources, interviews with	Foreign contractors are removed from multiple dual facilities	somewhat likely	definite yes	somewhat unlikely	very unlikely	definit	

analytic results

ground truth

compare