REMTECH 2024

Navigating New Frontiers:

The Role of Artificial Intelligence (AI) in Environmental Innovation

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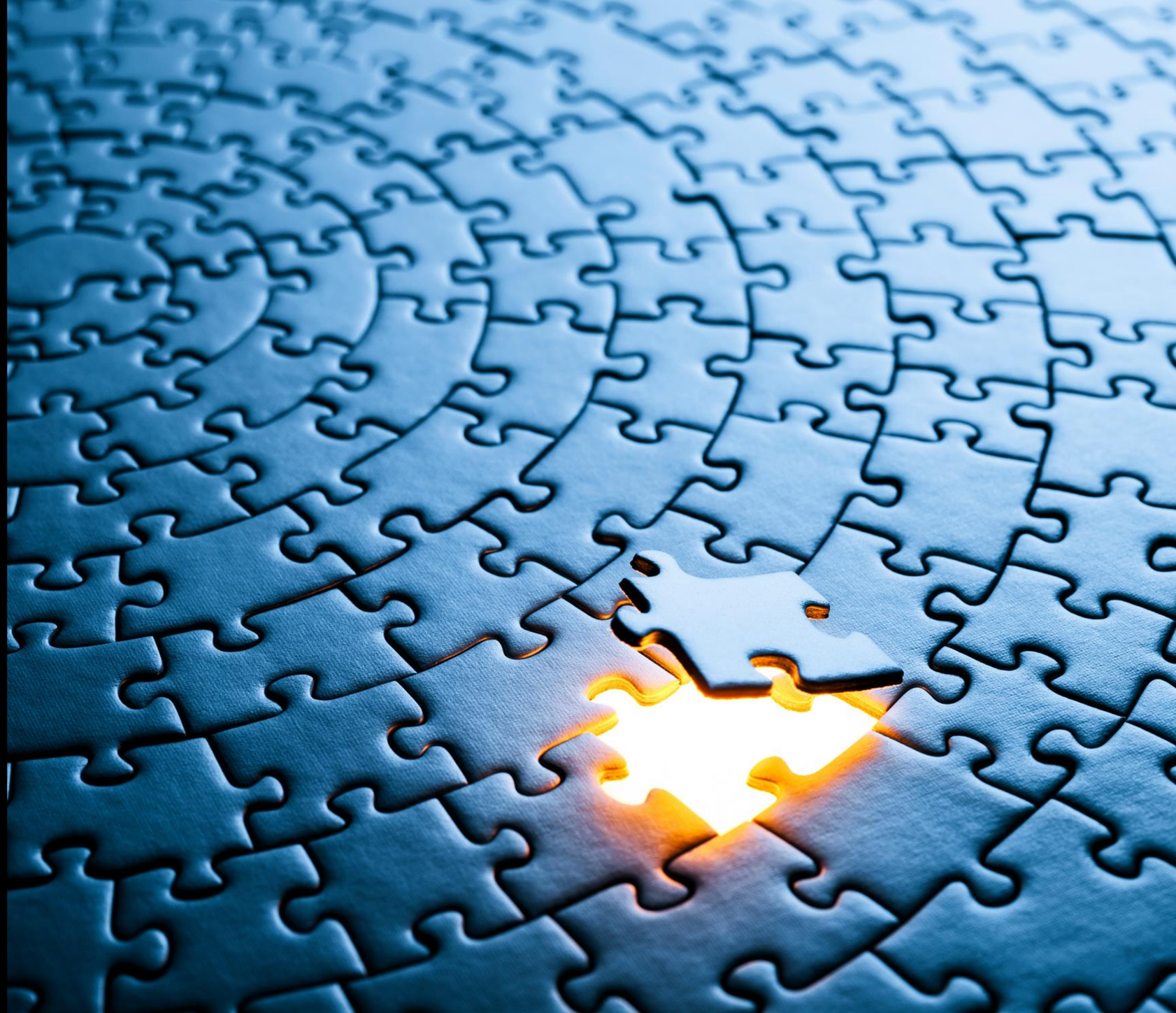
eco AI INNOVATES

trium ENVIRONMENTAL



Corporate INFORMATION

OUR TEAM

At TRIUM Environmental & ecoAI INNOVATES, our strength lies in our team of dedicated professionals who share a common vision of creating a smarter, more sustainable environment through the power of artificial intelligence. Our diverse team comprises world-class engineers, researchers, administration, marketing, business development and industry experts who bring a wealth of knowledge and experience to the table.

The partnership between BIZDATA and TRIUM represents a pivotal collaboration in the advancement of environmental technologies. This collaboration brings together world-class engineers and researchers, leveraging the combined expertise of renowned experts from great university institutions and the support of the governments of South Korea and Canada to make ecoAI a reality.

BIZDATA, known for its cutting-edge data analytics solutions, and TRIUM, a leader in innovative environmental remediation, have united their strengths to address pressing environmental challenges.

The convergence of expertise embodies a holistic approach to tackling environmental challenges. This collaboration exemplifies how industry, academia, and government can work together to create impactful solutions that benefit society as a whole. Through their combined efforts, ECOAI is poised to lead the way in harnessing AI for environmental sustainability, setting a benchmark for future initiatives in the field.

Introduction to Artificial Intellegence

Artificial intelligence (AI) is the simulation of human intelligence in machines, enabling them to perform tasks that typically require human cognition, such as learning, reasoning, problem-solving, and decision-making.

A MAJOR DIFFERENCE BETWEEN A TRADITIONAL COMPUTER PROGRAM AND AI

COMPUTER PROGRAM

Computer program follows a set of predefined instructions to perform specific tasks such as "Input", "If, then, else" and "Output)

AI SYSTEM

AI systems can learn from data, adapt to new situations, and make decisions or predictions without being explicitly programmed for every possible scenario ("Input", "Feature Selection", "Tree Construction", "Decision Making" and "Output)

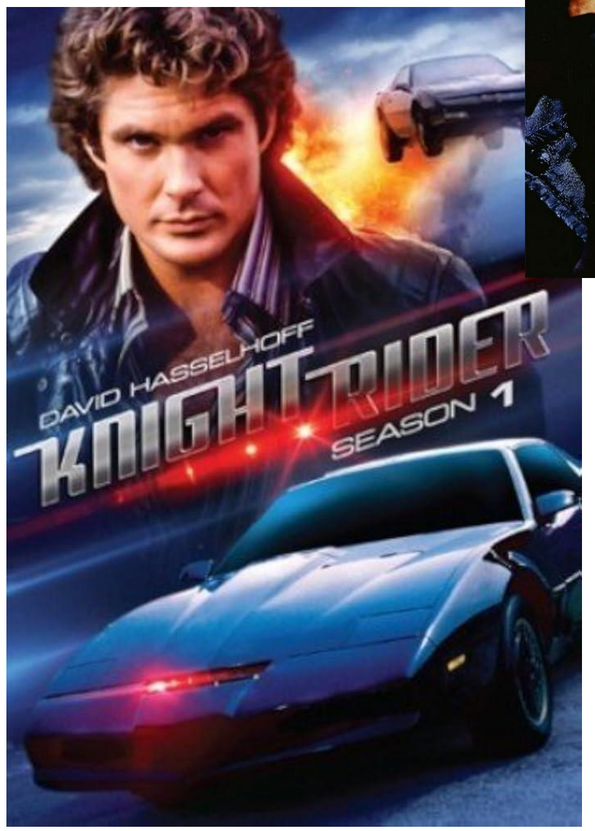
AI can significantly enhance user friendliness by enabling more intuitive and personalized interactions as it can understand natural language, learn user preferences, and adapt to individual needs, making technology more accessible and easier to use.

AI in Everyday Life

ChatGPT, Copilot, Google, YouTube, Amazon, etc.

Others

- Billboards – Adjust content
- Watches – Health monitoring/predictions
- Google Lens – image recognition/web content
- Fall/Crash Detection
- Video Games
- Navigation – Route and pattern analysis
- Facial Recognition – various facial patterns
- Adaptive charging of devices
- Spam Detection
- Autocorrect



Development of AI

1940's

Concept of AI by Neuro scientists

The human brain consists of electrical networks (on and off)

1960's - 1970's

Early Development

ELIZA, first natural language, Shakey the robot and Expert System

1990's - 2000's

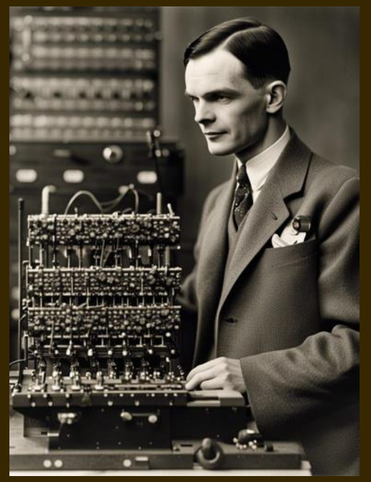
AI Resurgence

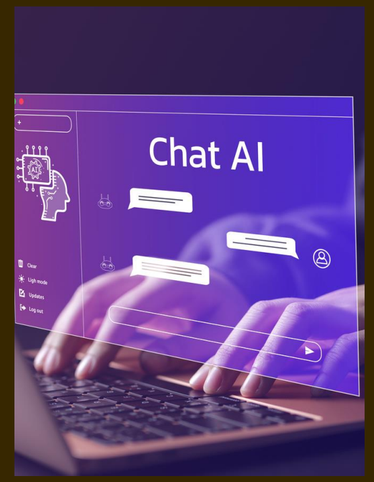
Better computing systems and internet and big data

2020's - Present

Everyday AI

General Purpose Technology (GPT), Large Language Model and many techniques used in a daily life





1950's

The Birth of AI

"Computing Machinery and Intelligence" by Alan Turing and "Artificial Intelligence" coined at Dartmouth Conference

1980's

Machine Learning

The rise of machine learning, soon AI winter due to unmet expectations and limited progress

2010's

Deep Learning

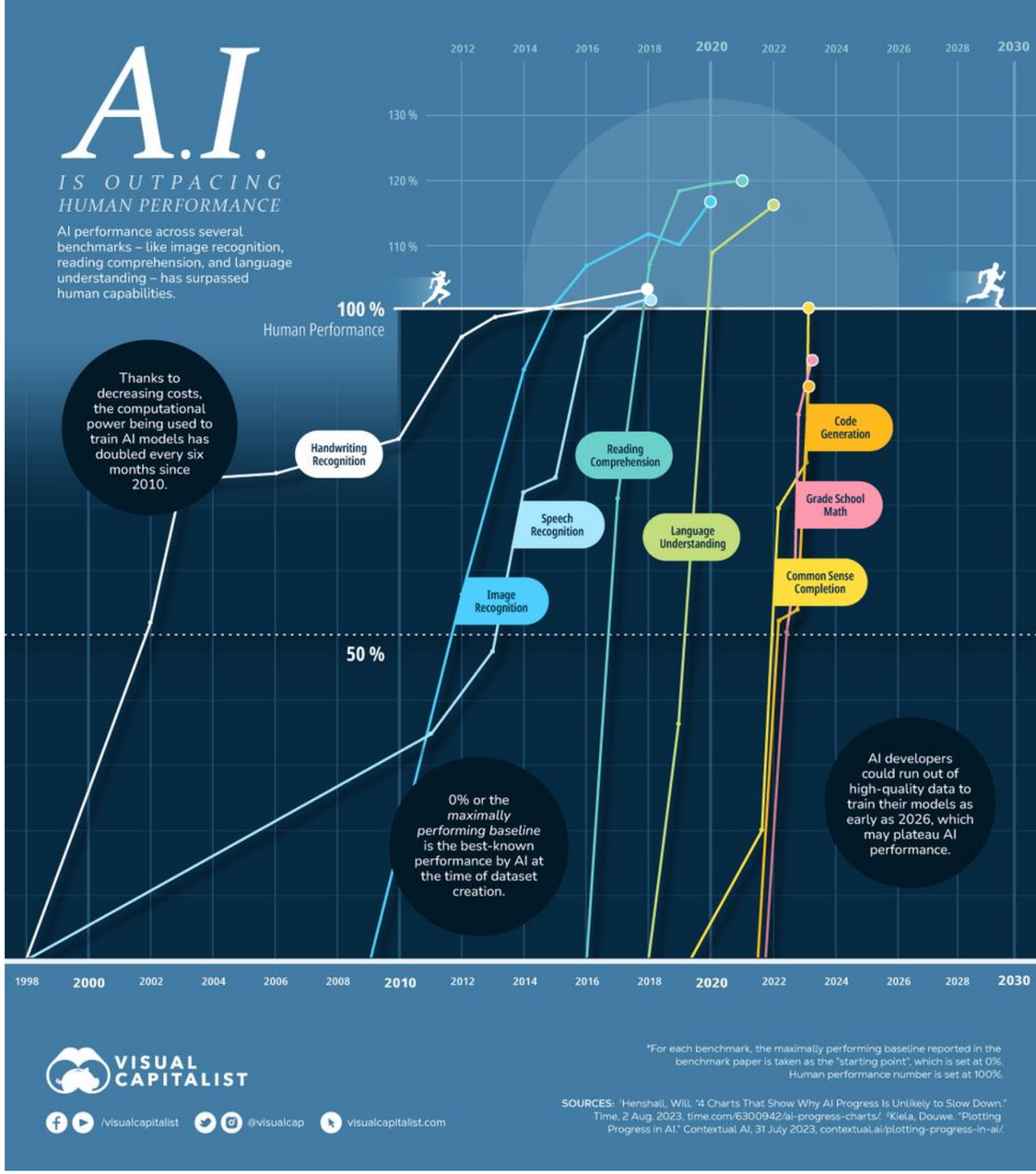
The rise of deep learning, Alpha Go

Trends of AI

- Current ChatGPT IQ at 155
- AI will run out of data by 2026, what then?

How can it get smarter without more to learn from?

People still have to give it data to evaluate. It takes those learnings, converts it into better understanding which in turn increases human potential.



[AI vs. Humans: Which Performs Certain Skills Better? (visualcapitalist.com)]

Key AI Techniques & Approach

Machine Learning (ML) Deep Learning (DL)

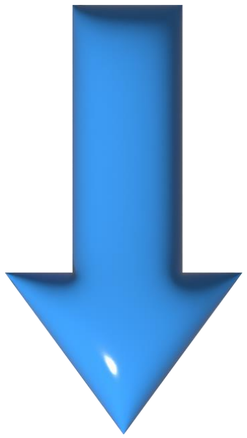
- Supervised Learning – learns from labelled data and make predictions
- Unsupervised Learning – finds hidden patterns in unlabelled data
- Reinforcement Learning – learns by interacting with the environment and receiving feedback in the form of rewards or punishments

Neural Networks (NN)

- Artificial Neural Networks (ANN) – basic structure with input hidden and output layers
- Convolutional Neural Networks (CNN) – processing grid type data (e.g. Image)
- Recurrent Neural Networks (RNN) – for sequential data such as time series, natural language

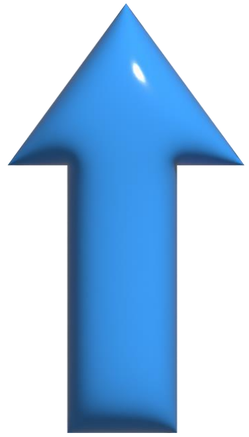
Natural Language Processing (NLP)

- Text Classification
- Sentiment Analysis
- Language Translation
- Speech Recognition



Regenerative AI

For improving, repairing, or maintaining existing systems or data



Generative AI

For creating new and original content

AI's Tacit Knowledge

Interconnections between subfields

Benefits, Challenges and Considerations

Benefits

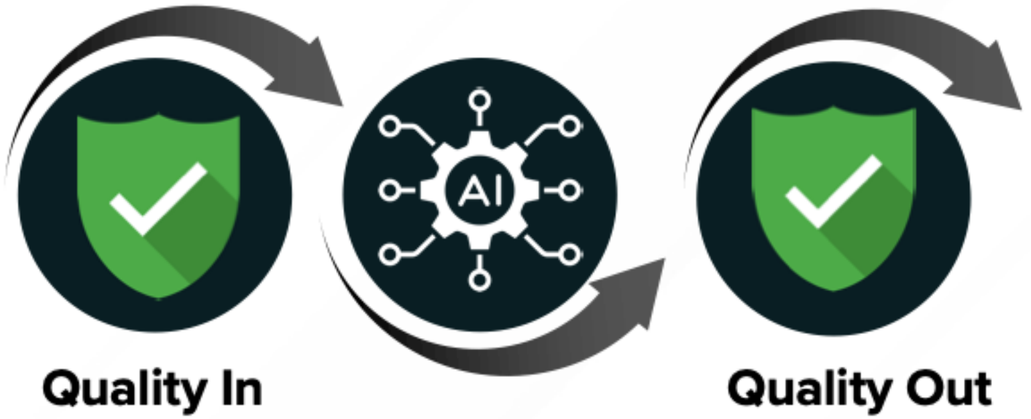
- Efficiency and reduced human errors & bias
- Accuracy
- Sustainability

Challenges

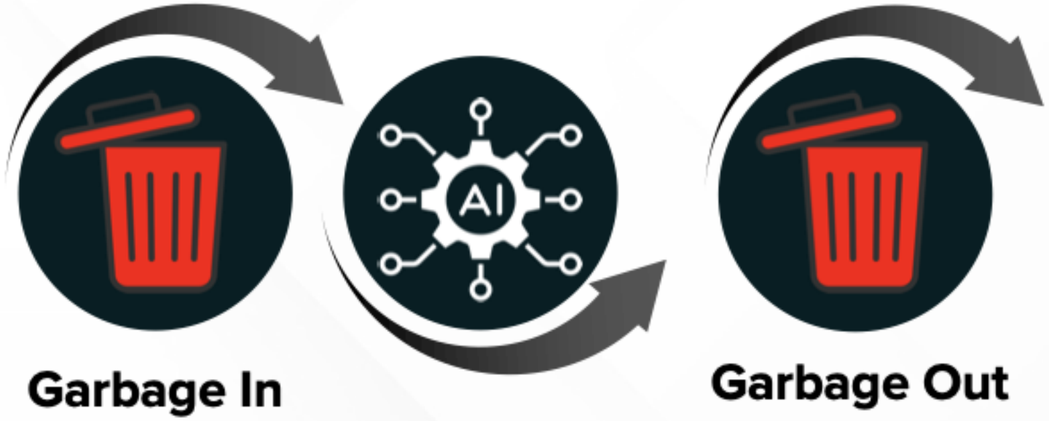
- Data Quality: Accuracy, Relevance and Representativeness
- Ethical Considerations
- Development costs

Considerations

- AI's capacity for handling vast amounts of data, making predictions and optimizing complex systems in real time
- Synergy in environmental applications by interconnections



Example : Accurate and reliable results and recommendations



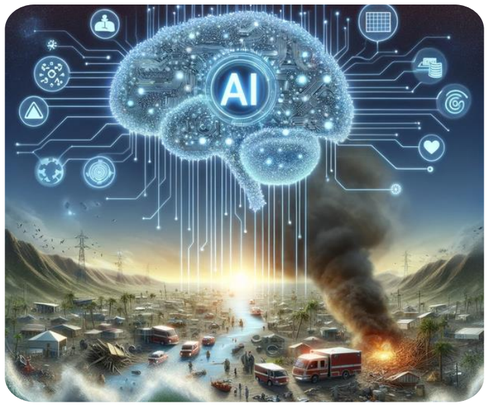
Example : AI Hallucination, biased prediction, irrelevant results.

Currently Available Applications

AI BASED FIELD SOIL SCREENING TOOL

AUTONOMOUS WATER & WASTEWATER TREATMENT

AI BASED DISASTER PREVENTION MANAGEMENT



AI BASED ENVIRONMENTAL DATA INTERPRETATION AND REPORTING

KE

NS

Environmenta
Management
Interpretat

- Managing and analyzi
  data s
- Assist in decision
  recommen
- Generating environ

onitoring, Drones,
d/or Remediation
Operations

sensors, photos, field
nd analytical data for
y warning, feedback
ision making

Are you satisfied with the effectiveness & reliability of the hydrocarbon soil characterization tools you currently use in your projects?

You can see how people vote. Learn more

V. Satisfied - Meet our needs	0%
Satisfied – Needs improvement	14%
Neutral – Meh!	0%
Unsatisfied – We need better ✓	86%

Petroleum Hydrocarbons

A Photoionization Detector (PID) or Flame Ionization Detector (FID) is a type of gas detector used to measure volatile organic compounds (VOCs) and some inorganic compounds **in the air.**

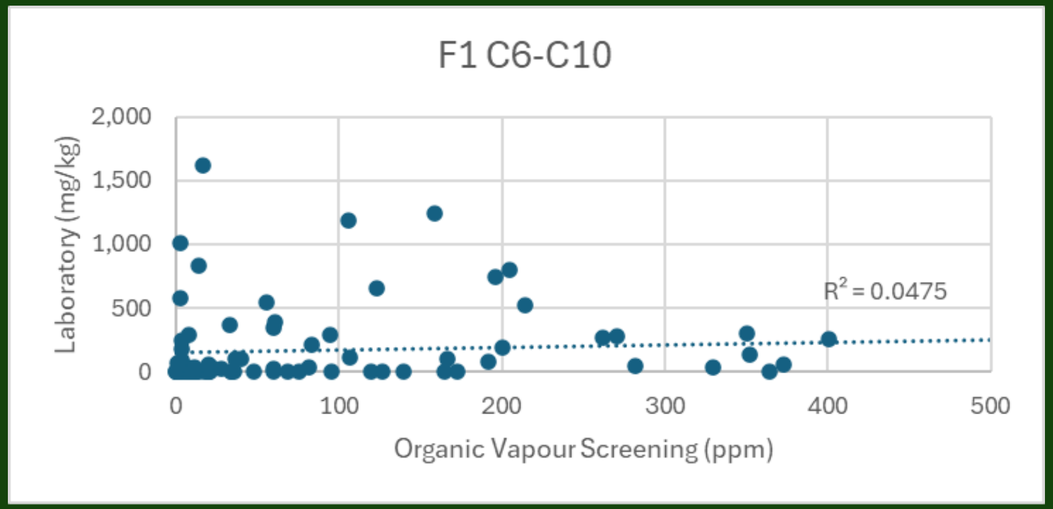
- Limitations
  - Sensitive to Humidity
  - Interference
  - Maintenance: The UV lamp and sensor can become contaminated quickly, requiring regular cleaning and calibration
  - Limited Selectivity: may not distinguish between different types of VOCs
  - Over limit/calibration
  - Soil type/VOC

EXAMPLES OF A CURRENT FIELD SCREENING PRACTICE

Petroleum Hydrocarbons

- Field Screening plagued by:
  - Error
  - Preparation
  - Calibration
  - Correlation
  - Collection
  - Temperature
  - Contaminant
  - User
  - Etc.

Reliable OVA?



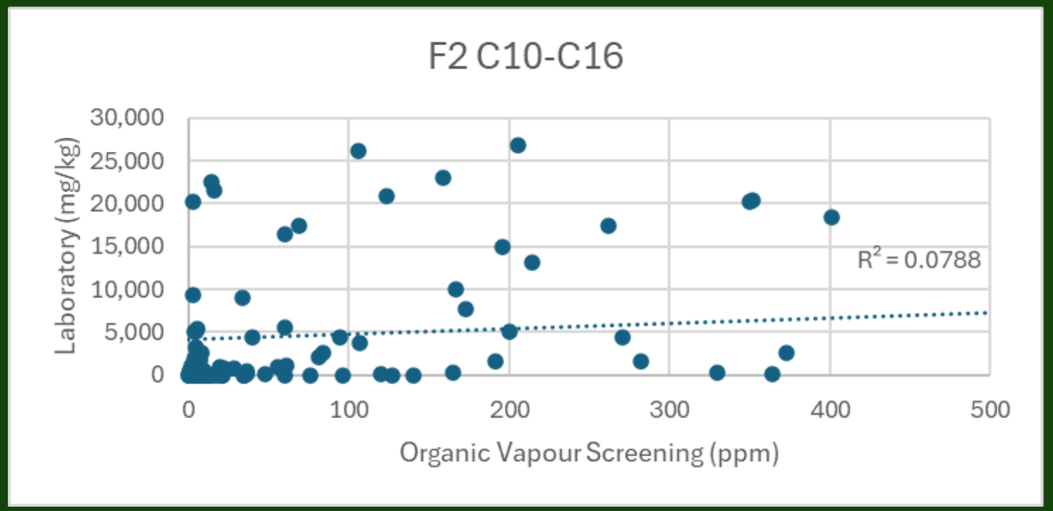


Table 1 **Failure Rate of AESRD Surface and Contamination Audits (GoA, 2010)**

Alberta Environment/SRD Surface Audits	2003 to 2011	9%
Alberta Environment/SRD Contamination Audits	2003 to 2011	28%

- The Power of Artificial Intelligence in Soil Analysis
- Speed and Efficiency in Assessment & Remediation
- Unmatched Precision for Complex Challenges
- Cost–Effective Solutions for Sustainable Outcomes
- Versatility Across Various Applications

AISCT®

“EH-sist”

MODELS

Presently Developed AISCT® Models

AISCT® - Petro

Spectral Based Technology

Designed to test for petroleum hydrocarbons in Soil.

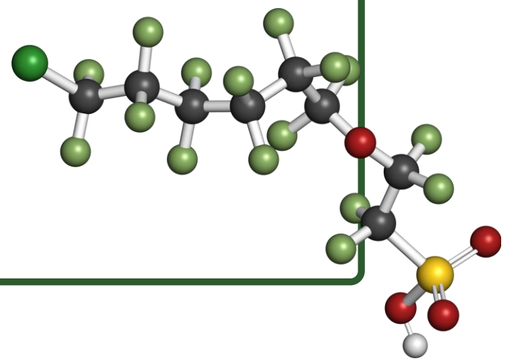
AISCT® - Sal

Potential Based Technology

Designed to test for Chloride and Salt compounds in Soil & Water.

AISCT® - Flo

PFAS - UNDER RESEARCH & DEVELOPMENT



The Game Changing Technology: How AISCT® is Transforming Environmental Remediation

AISCT® is a tool designed for rapid and accurate soil analysis, with the aid of state-or-the-art artificial intelligence and Big Data Algorithms. It relies on a constantly improving database of validated correlations to provide results for drilling, excavating, or surface soil sampling. It delivers consistent, reproducible results within 20 minutes, making it a versatile solution for on-site or centralized soil analysis

Four Years of Pioneering Innovation and Advancement

NSERC Alliance Grant

NRC-IRAP Canadian International Innovation Program
(CIIP) NSERC Alliance Grant

2019

Preliminary Tests

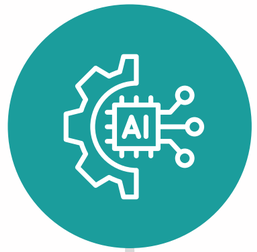
- Feasibility tests
- Sensor evaluations
- Soil extraction tests

2020

Sensor System Development

- Sensor Optimization
- Dataset Production
- Database Building

2021



AI Model Development

- Data preprocessing Algorithm Development
- Database development

2022

AI Model Verification

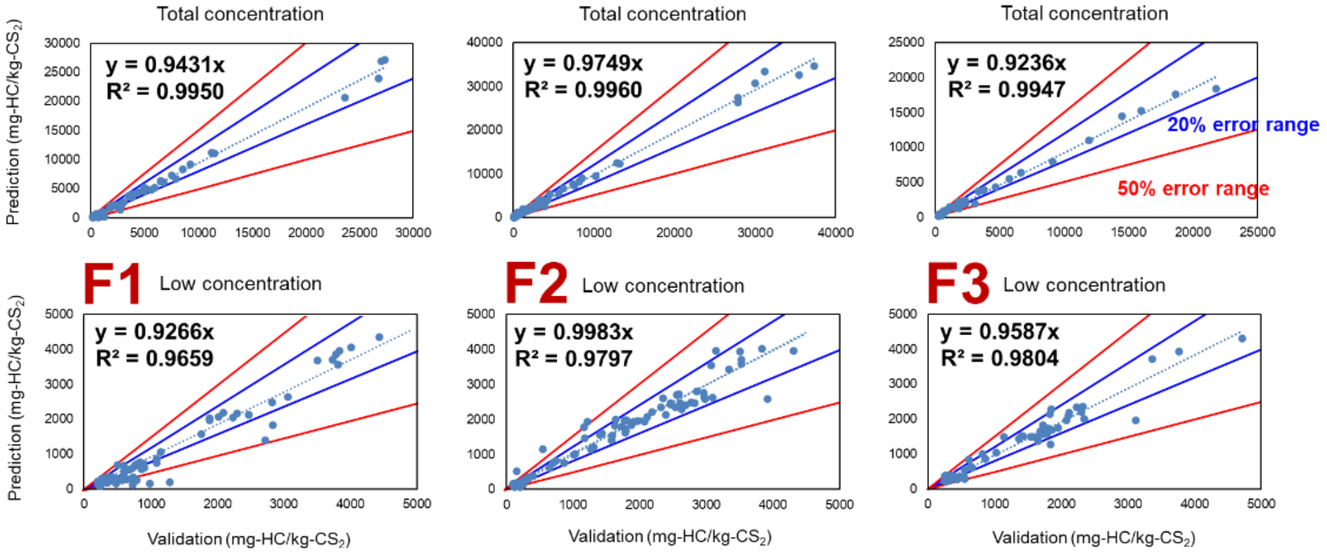
- Prototype fabrication
- Verification tests with field soils
- Field demonstrations

2023

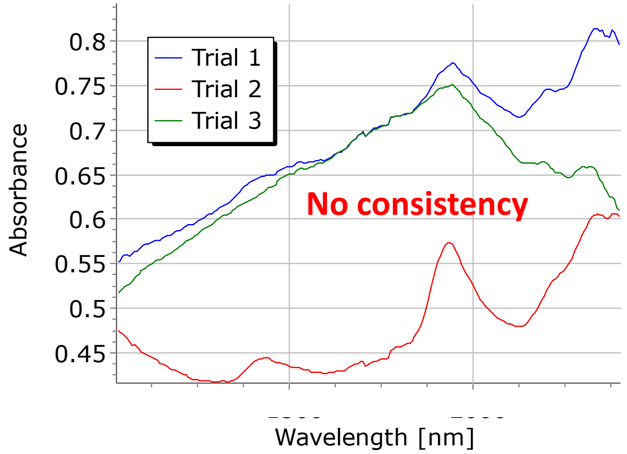
Eliminating Error and Noise

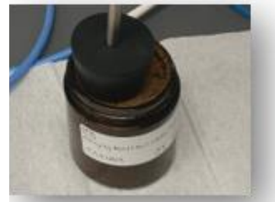
With Spectral based analysis, multiple issues can cause bias.

- Example of poor consistency due to moisture and other interference
- Without reliable and repeatable methodologies, AI prediction is impossible
- Multiple layers of algorithms, no one single option

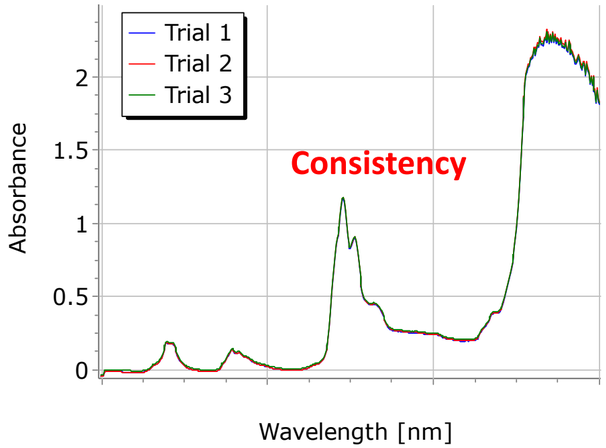


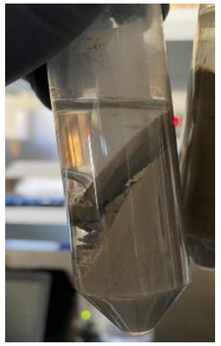
Surface scanning method



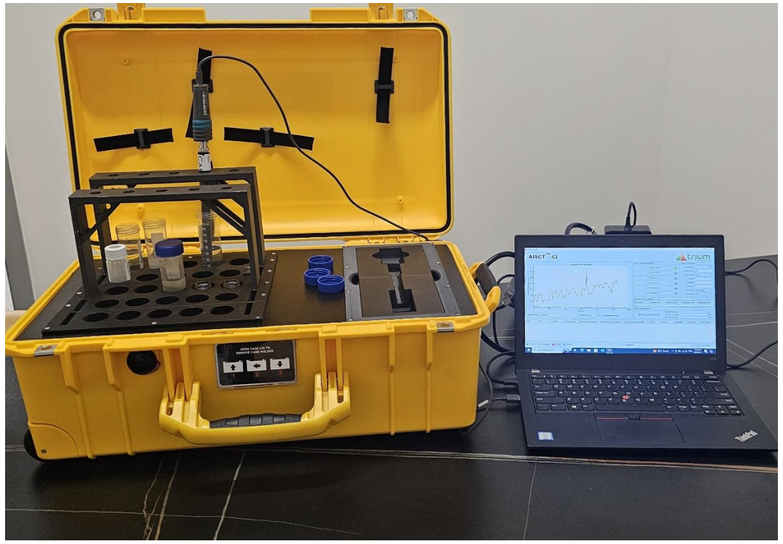


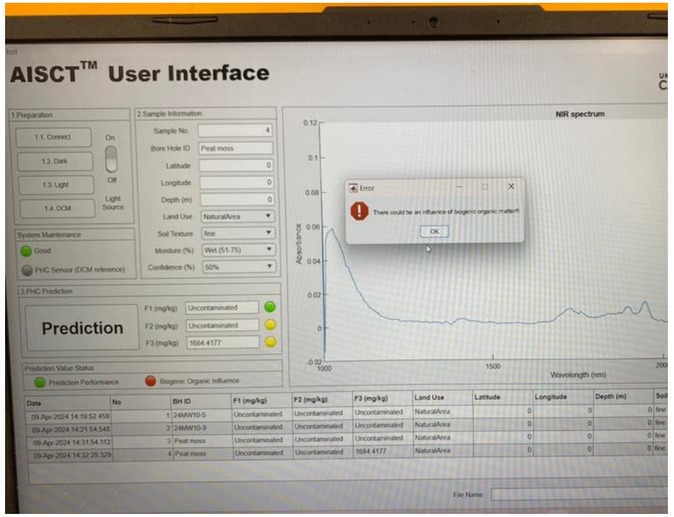
AISCT method





Some Live Images During Testing & Development





AISCT® - Petro Model Validation with Field Soil Samples

	Laboratory			AISCT®		
	F1	F2	F3	F1	F2	F3
1	0.0	0.0	0.0	uncontaminated	uncontaminated	uncontaminated
2	0.0	0.0	0.0	uncontaminated	uncontaminated	uncontaminated
3	19.8	51.4	143.8	uncontaminated	uncontaminated	uncontaminated
4	16.9	48.9	158.4	uncontaminated	uncontaminated	uncontaminated
5	15.5	43.4	139.0	uncontaminated	uncontaminated	uncontaminated
6	112.0	685.2	510.6	uncontaminated	775.4	uncontaminated
7	56.4	381.0	317.2	uncontaminated	382.2	uncontaminated
8	59.2	383.2	353.4	250.0	367.2	uncontaminated
9	28.2	[illegible]	162.6	uncontaminated	[illegible]	uncontaminated
10	22.9	[illegible]	[illegible]	[illegible]	[illegible]	uncontaminated
11	153.6	1200.0	967.9	uncontaminated	1063.0	uncontaminated
12	169.9	1057.8	818.6	uncontaminated	967.4	uncontaminated
13	258.9	1123.1	828.4	228.4	1052.9	uncontaminated
14	176.0	829.4	660.6	uncontaminated	764.7	uncontaminated
15	21.2	50.4	119.3	uncontaminated	uncontaminated	uncontaminated
16	1682.3	534.3	195.3	1704.8	581.6	uncontaminated
17	351.2	1298.4	73.2	289.6	1046.6	uncontaminated
18	25.2	36.1	83.4	uncontaminated	uncontaminated	uncontaminated
19	365.2	1518.4	89.7	352.4	1560.9	uncontaminated
20	260.8	1104.6	88.4	215.3	974.8	uncontaminated
21	2094.3	4952.8	3052.3	2296.7	5237.8	3055.8
22	2199.9	5856.7	3819.4	2385.1	6020.7	3703.6
23	5391.3	6712.8	3945.8	5515.0	6895.1	3965.9
24	2159.0	3213.7	1979.3	2276.3	3356.9	1848.7
FE451	38.5	750.2	681.4	uncontaminated	618.9	uncontaminated

>95% Correct Prediction

FACTS

>95% correct prediction of outcome compared to guideline

Strong correlation to laboratory analysis

Consider acceptable QA/QC can often be +/- 40% in an analytical test.

Sample	F1			F2			F3		
	GC	AISCT®	% Diff.	GC	AISCT®	% Diff.	GC	AISCT®	% Diff.
1-1	2094.3	2296.7	9.6%	4952.8	5237.8	5.7%	3052.3	3055.8	0.09%
1-2	2199.9	2385.1	8.4%	5856.7	6020.7	2.8%	3819.4	3703.6	-3.1%
1-3	5391.3	5515.0	2.3%	6712.8	6895.1	2.7%	3945.8	3965.9	0.5%
1-4	2159.0	2276.3	5.4%	3213.7	3356.9	4.4%	1979.3	1848.7	-7%

AISCT® - Petro Field Results
CLAY BASED SOIL

>95% Correct Prediction

Samples	OVA (ppm)	
1	0	
2	5	
3	5	
4	5	
5	100	Excavated
6	5	
7	35	
8	45	Excavated
9	35	
10	15	
11	20	
12	45	Excavated
13	45	Excavated
14	15	
15	0	

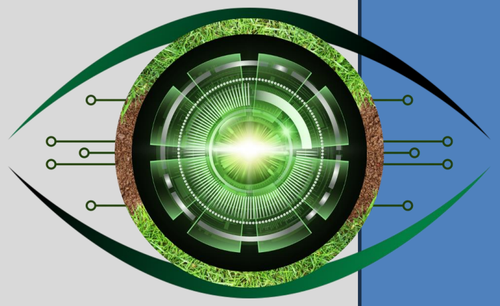
AISCT

FACTS

- >95% correct prediction of outcome compared to guideline
- Strong correlation to laboratory analysis
- Excavated material represented >$10,000 in additional/unwarranted cost

AISCT® - Petro Field Results
SILT/CLAY BASED SOIL

	Test Pit ID	IBL (ppm)
PID analyzed	TP3-1	76
	TP3-2	10
	TP3-3	12
AISCT® analyzed	TP3-4	20
PID analyzed	TP4-1	21
	TP4-2	1
	TP4-3	2
	TP4-4	1
	TP5-1	6
AISCT® analyzed	TP5-2	4
PID analyzed	TP5-3	8
AISCT® analyzed	TP5-4	1
PID analyzed	TP6-1	48
	TP6-2	10
AISCT® analyzed	TP6-3	4
	TP6-4	1
PID analyzed	TP7-1	6
	TP7-2	1
	TP7-3	2
	TP7-4	1
PID analyzed	TP8-1	11
	TP8-2	1
	TP8-3	2
	TP8-4	1



AISCT

FACTS

- In each testpit the highest PID value was analyzed as normal practice
- In 33% of the test pits the wrong decision would have been made.
- All of the exceedances were in samples with less than 20 ppm on the PID
- AISCT® predicted the soil sample outcome correctly >95% of the time.

Challenges of Measuring Chloride

- EC and other indicator parameters biased by other ions and salt makeup.
- Lack of technologies for ion specific analysis.
- High accuracy required for environmental regulations.
- Importance of consistency and reliability in results.
- EP offers opportunity to measure
  - On-site baseline correction procedure and leveraging AI predictions

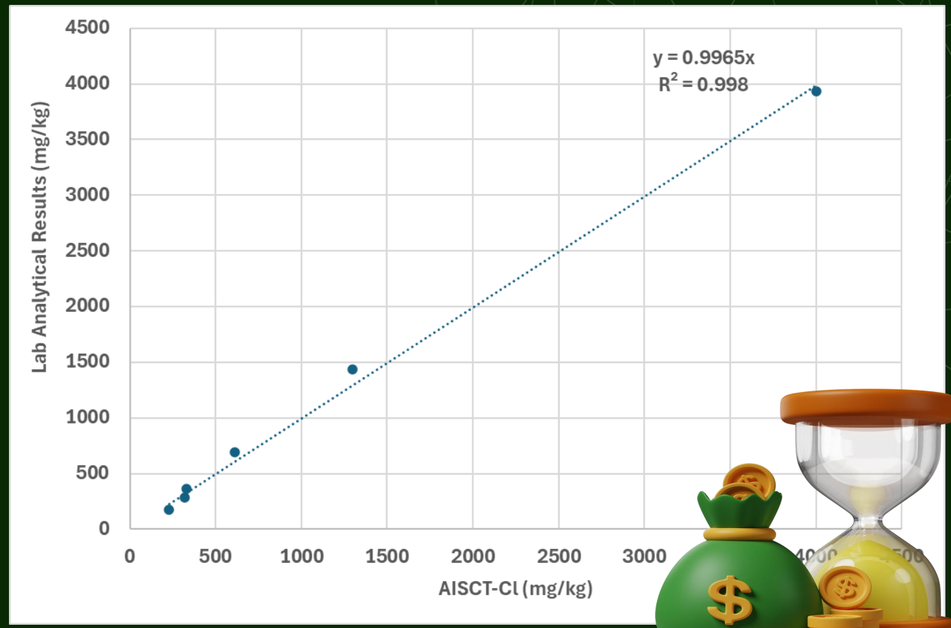
AISCT® - Sal Field Results
CLAY BASED SOIL

Laboratory (mg/kg)	AISCT® (mg/kg)
Cl	Cl
N.D.	56.4
100.7	115.8
3233.8	3612.8
Over Max.	Over Max.
1129.8	1636.7
55.9	104.3
457.7	275.5
778.8	1111.1
	2
345.3	410.1
1051.8	1259.9
968.0	1026.1
N.D.	74.9
N.D.	N.D.
N.D.	N.D.
N.D.	55.3
N.D.	61.0

>95% Correct Prediction

FACTS

- >95% Correct Prediction
- Strong correlation to analytical results
- Soil, groundwater or surface water



Cost Saving Scenario – 1 day on-site

	Samples <50 ppm OVA	Samples >50 ppm OVA
Total Number of Samples	34	17
Number Exceeding Lab	1	8
Number Exceeding AISCT®	2	8
Percent Samples Exceeding (Lab)	3%	47%
Percent Samples Exceeding (AISCT®)	6%	47%
Volume of soil "saved“ (Assuming 100 m3 per)	-100	900
$ saved $100/m3 or $60/T	-$ 10,000.00	$ 90,000.00
Total Saved	**$ 80,000.00**	

WHAT DOES USING AI PROVIDE?

RAPID TESTING

- To Excavate or Not to Excavate
- To Drill or Not to Drill
- Spill/Emergency Response
- Large or Small

PRECISION & ACCURACY

- Correlated
- Predictions and Concentrations
- CSM Development
- Closure Programs
- Drilling and Sampling

DECISIONS

- Defines Go/No Go
- Saves Soil to Disposal
- Directs Excess Soils
- Only Needed Samples to Lab
- Fewer Rush Charges
- Reduces Standby

Thank You!

INNOVATION HUB

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