IAEA
International Atomic Energy Agency

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Joint FAO/IAEA Centre
Nuclear Techniques in Food and Agriculture

AI4Atoms Technical Meeting:
Summary of Food and Agriculture Working Group Sessions

Session 1: On-line, 27 October 2021 15:40 – 18:30 (Vienna, CET)
Session 2: On-line, 28 October 2021 15:40 – 17:55 (Vienna, CET)

Technical Officers: Mr Simon KELLY and Mr Gerd DERCON

Working Group Session 1: Programme

Day	Time	Duration	27-Oct
27-10-2021	15:40	00:05	**Working Group Session #1** **Food and Agriculture - Introduction**
	15:45	00:25	**Frank Albinet (independent statistics and AI consultant, France)** *Optimizing the remediation of radioactive contamination in agriculture using Deep Learning*
	16:10	00:25	**Kate Kemsley (Quadram Institute Bioscience, United kingdom)** *AI applied to NMR spectral data processing for food authentication*
	16:35	00:25	**Yamine Bouzembrak (Wageningen Food Safety Research, Netherlands)** *Machine learning applied to prediction of Food Fraud events*
	17:00	00:10	**Comfort break**
	17:10	00:25	**Modou Mbaye (Institut Senegalais de Recherche Agricole, Senegal)** Deep Learning Approach for Calibrating Cosmic-Ray Neutron Sensors (CRNS) in Area-Wide Soil Moisture Monitoring
	17:35	00:25	**Anne Gobin (VITO/KULeuven, Belgium)** Remote sensing data for agricultural soil management using machine learning algorithms
	18:00	00:30	**Panel Discussion (including Hans Marvin from Plenary Session)** Panel discussion and round-up of potential cross-cutting applications of AI and machine learning in the Agri-food space
			End

State of the Art (1)

Some lessons learnt from the keynotes – Food and Agriculture

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- **Enhanced data availability** allowed to implement AI approaches
- **Variation** in sampling, sample preparation and analysis is a **bottle neck for linking data**, but **AI** can assist here to **align datasets**.
- **Improving prediction**
  - Chemometrics versus AI in MIRS - NMR and other analytical techniques
  - Calibration of instruments
  - Calibration transfer (still limited experience)
  - Fingerprinting combined with AI (including stable isotope signatures)

State of the Art (2)

Some lessons learnt from the keynotes – Food and Agriculture

- **Data fusion** from different sources – data access is a challenge
  - AI applications allowing linking point, local and regional/global information
- **Sharing knowledge** instead of sharing data
- **Online open-access data mining** for enforcement
- System approach combining **AI and expert knowledge**
- From prediction to **explainability**
- **Internet of Things combined with AI and decision-support** is a fast-growing domain

Working Group Session 2:

Focusing on next steps, IAEA's role and expected outcome

Finding synergies across Food & Agriculture disciplines

- Data collection and ownership
- Data sharing (and ethics?)
- Protocols and verifying models (uncertainty)

Using AI in enforcement and for informing policy

Education and training

- Dissemination and best practice
- Real world examples and success stories
- Sustainability of the working group

Next steps (1)

Data for AI applications in Food & Agriculture

- ✓ **Limited data availability** as compared to other scientific disciplines
  - ✓ *Expensive and labour intensive data collation and annotation, and analysis (specialised devices and expertise needed)*
  - ✓ *Agronomic experiments often take years, so data collection is slow*
- ✓ **FAIR principle** (findability, accessibility, interoperability, reusability of digital assets, with minimal human intervention)
  - ✓ *A set of principles to ensure that the data are shared in a way that enables and enhances reuse by human and machines*
  - ✓ *Metadata may link the datasets through AI*
- ✓ **Federated learning** as basis for sharing knowledge instead of sharing and moving data (training the model from one database to another database)
- ✓ AI can assist in **calibration transfer for analytical instruments, essential** to develop large uniform datasets (e.g. spectral analysis)
- ✓ **Computing power** may **no longer** be **a major limitation**
- ✓ **AI based digital twins** allow to explore processes in virtual reality (based on gaming applications)
- ✓ **Data fusion and integration are a challenge** due to the wide range of data types (from farm to fork, from point to region)

Next steps (2)

Using AI in explaining processes, informing policy and enforcement

- ✓ **Explainable AI**
  - ✓ Explainability should not be a limitation for deployment of AI techniques
  - ✓ But limited explainability may be needed to make AI attractive to enforcement or policy makers and to make sure that the end-user understands it in their environment.
- ✓ **Explainability of processes through AI** is more for the domain experts, not so much for the end-user.
  - ✓ However, main drivers for a certain result (classification) should be explainable for the end-user (so not just black box).
- ✓ **Algorithms may be not inclusive enough**, so that it may be a source for certain bias (how to overcome?).
  - ✓ This is linked to the ethical questions. And how can we use such models?
- ✓ **Reactive AI modelling** is embedded in the legal framework (required to be done), and **proactive AI modelling** is not embedded in the legal framework (if not happened yet, how to justify to take action to prevent it).
- ✓ Can AI approaches, such as data mining, also be a basis for **keeping track of rapidly increasing amount of information** (online/in papers)?
  - ✓ It is already being done, such as for crop yield data, prediction of zoonotic diseases, impact of climate change on diseases (shell fish), …

Next steps (3)
Education and training

- ✓ AI **started to be included in curricula of universities and faculties** for agricultural sciences, mainly at PhD, but also at MSc level.
  - ✓ In Wageningen included in MSc courses (different research programmes working together on AI, including teaching, 3 million Euro per year available for AI research, with four chairs).
  - ✓ In KULeuven computer science and engineering driven, with some introduction in the field in bio-engineering (more at PhD level).
- ✓ Sufficient **information available online for implementing AI** (excellent courses available)
- ✓ But **platform** would be **needed to guide students**.
- ✓ Theoretical and practical AI are often **separate fields**.
  - ✓ For instance, MIRS – AI applications are carried out by soil scientists, and not mathematicians.
  - ✓ More **interaction** is needed.
- ✓ Not just universities but also **high schools** (secondary schools) have a role to play in education in the field of AI (to ensure capacity and interest later onwards).
  - ✓ Gaming can be a basis.

Accelerating Progress – IAEA's role

- ✓ Through **Coordinated Research Projects**, the Joint FAO/IAEA Centre develops new AI approaches.
- ✓ Through **TC projects and IAEA capacity building** programmes, know how on AI applications can be disseminated to Member States.
- ✓ Progress is stimulated by **interdisciplinary exchange** of expertise and experiences **across scientific fields** (across **different departments** of the IAEA)
  - Theory versus application
- ✓ The FAO/IAEA AI Working Group decided to meet **once a year to exchange experience** on approaches, data exchange, and project development.
  - ✓ Let us know if you are interested in joining us.

Expected Outcome

- AI helps to **fuse and integrate data and datasets**
  - From local to global datasets
- AI **innovates model development** for enhanced decision support and enforcement in a scientific and ethical way (based on FAIR principles)
- AI becomes a **mainstream tool for better use** of nuclear and isotope data
- AI is **integrated in education programmes** at different levels

AI for Good

- Based on the AI4Atoms TM Food and Agriculture Working Group outcomes, one of our speakers **Franck Albinet**, will have the opportunity to speak at the **"AI for Good"** https://aiforgood.itu.int on 18-11-2021; a major initiative organized by the ITU with 38 UN sister agencies

- Welcome to this event! And you can register already.

Thank you for your participation in the Food and Agriculture Working Group Sessions

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