TraiNDE : SIMULATORS FOR NDT

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NORSK FORENING FOR IKKE-DESTRUKTIV PRØVING
NORWEGIAN SOCIETY FOR NON-DESTRUCTIVE TESTING

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Outline

- Introduction
- Simulators for UT Inspection
- Simulators for RT Inspection
- Benefits of simulators
- Conclusion

About EXTENDE : Our activities

World wide CIVA DISTRIBUTION and technical SUPPORT

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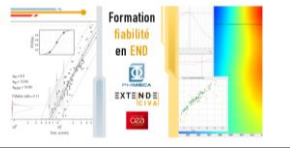

TRAINING COURSES :
CIVA, « Reliability in NDE »

CONSULTING : qualifications, design, expert assessment, computations, …

CIVA N·D·E

Flux®

Altair | HyperWorks

TRAINDE UT

TRAINDE RT

TraiNDE : Virtual training tool for NDE operators

LRQA CERTIFIED ISO 9001

10487010

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About Simulators

Definitions from Merriam-Webster

Definition of *simulator*

A device that enables the operator to reproduce or represent under test conditions phenomena likely to occur in actual performance.

Example of *simulator* in a Sentence

A flight simulator used by pilots

Let's do the distinction from *simulation* tools :

Computer-operated software that model physical phenomena based on input parameters and providing outputs in relevant views/maps for analysis :
Theoretical model of an inspection which **does not aim to reproduce the gestures and the sequences** of real operations.

TraiNDE: The NDT Simulator

A brand

of virtual products for training and skills maintenance support for Non-Destructive Testing

Products

to train operators on :

- Manual UT
- RT (X & gamma)

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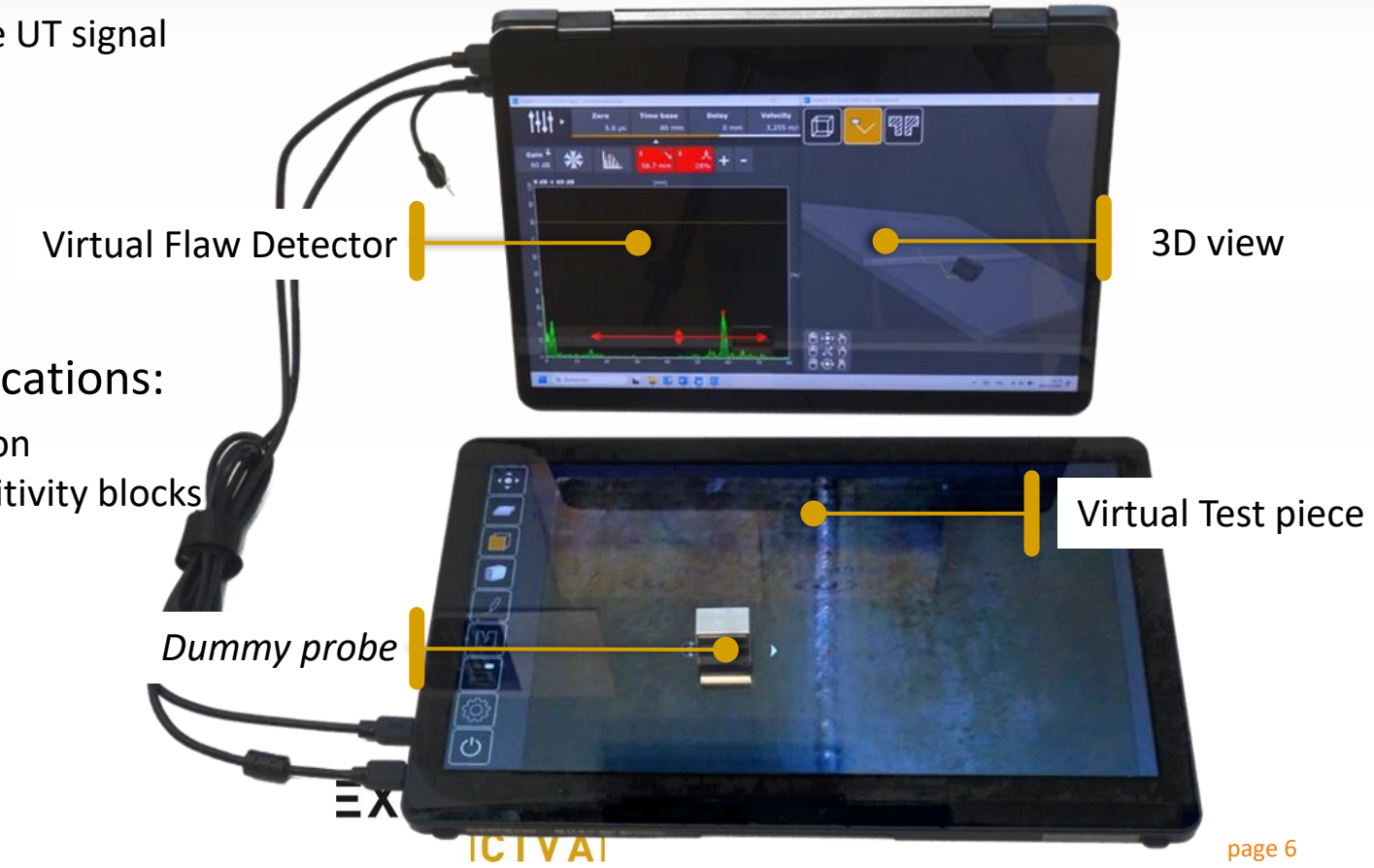
TraiNDE UT

- The **innovative** UT simulator for NDT operators

- Virtual inspection tool (test piece image on touch screen)
  - Dummy probe localized on the screen
  - Real time UT signal



- Many applications:
  - Calibration
    and sensitivity blocks
  - Plates
  - Welds

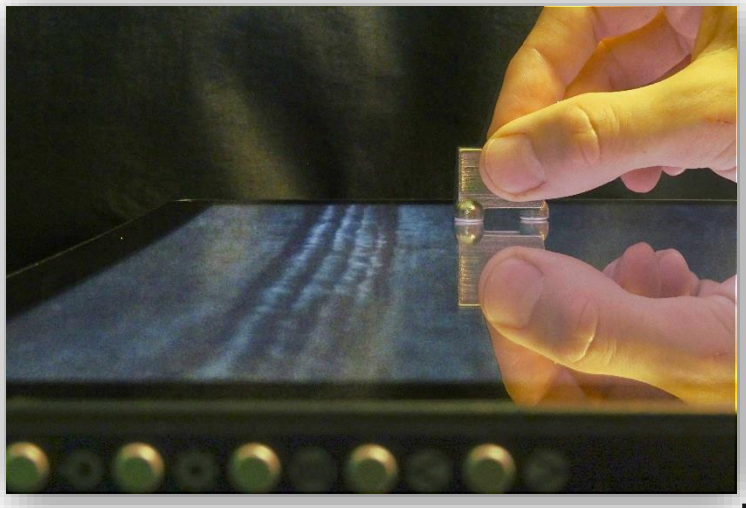
TraiNDE UT concept

For manual UT inspections

Operator analyses the signal that depends on:

- Probe position/orientation on the part
- The presence of defect(s)

=> diagnostic



TraiNDE UT

- Includes databases of signals (experimental, simulated or combination)
- Displays the signal related to the dummy probe position on the virtual test piece

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TraiNDE RT

Software

Virtual Reality

- RT control simulator in virtual reality (or PC version)
  - Includes the entire radiographic chain,
  - X and gamma sources,
  - Incorporates simulated images from databases for the most common techniques,
  - Displays the image corresponding to user-defined parameters, as well as a report of the RT shoot and potential mistakes.

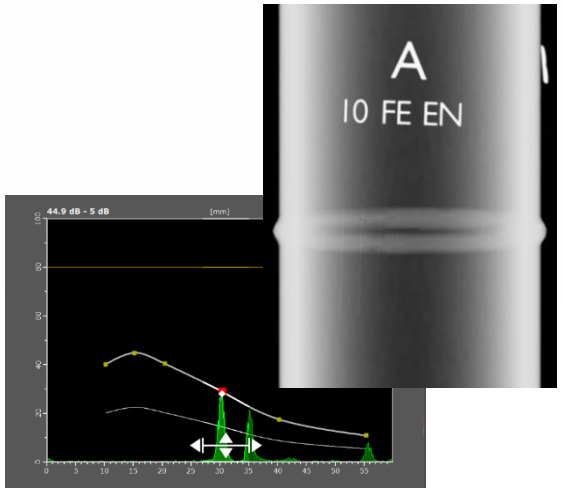
Inside TraiNDE RT

- Virtual radiography inspection in **virtual reality** or **PC version**
  - Handling of IQIs, markers
  - X-ray room

- Many exercises:
  - Tubes, elbows
  - Welded plates
  - Cast parts
  - Hundreds of images available per exercise (good or bad shots…)
- X or gamma shots (Ir192 for now)
- Steel and Alu X charts
- Analysis tools, error reports

Where does come the data ?

- Experimental data
  - Advantage : Very realistic by nature
  - Drawback: Time consuming and costly data acquisition
- Simulated data
  - Advantage: Fast data acquisition of many scenarios, easy to add flaws
  - Drawback : Might be less realistic, “too perfect”
- In TraiNDE:
  - RT: Simulated data provide very realistic rendering
  - UT : Acquired on real samples for many cases, simulation used for other ones



- Trends: Let’s combine both types of data !

See “Hybridize experimental and simulated signals to accelerate the creation of database for virtual training tools of UT operators”, B. Puel, in the proceedings of WCNDT 2024

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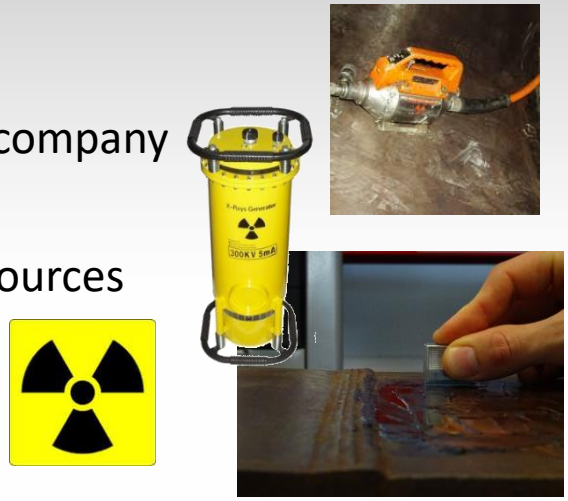
Challenges and Benefits

- Limited test pieces:
  - Can be expensive
  - Requires extensive storage space, needs periodic calibration
  - May require special equipment for handling
  - Only one student can utilize a piece at a time
  - Lack of existing blocks (i.e. HTHA samples)
- Benefits of simulators:
  - **Increase** the number of inspections/cases covered per trainee :
    1 TraiNDE in 1 Laptop ~ 30 applications ! → Cost-Effective
  - Multiple trainees can **work on the same inspections** while the trainer shows
  - **Easy to switch** from setup of one piece to another
  - Some **flaws can randomly move** or disappear between 2 trials
    → Unlimited number of tests

Challenges and Benefits

- Safe access to equipment:
  - Limited number of x-ray and gamma-ray sources per company
  - Limited access to X-ray room and UT lab
  - Safety courses required before handling radioactive sources
  - Risk of environmental and field conditions

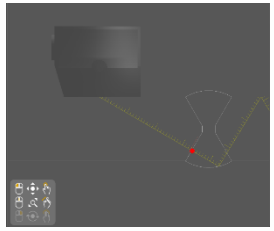


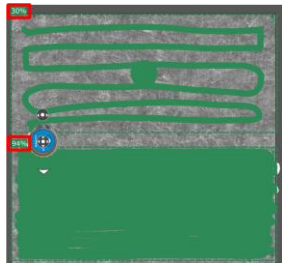
- Benefits of simulators:
  - No conflict if the source or scope is needed onsite
  - No risk : You can make mistakes !
  - New trainees can start hands on training on day 1
  - No consumables, no film storage, no couplant
  - Easy to transport
  - Standard and light hardware: More suitable for remote training conditions
  - You can train whenever and wherever you want : Practice more !

Challenges and Benefits

- Complexity to understand physics:
  - Most of the phenomena are invisible
  - No/Few digital assistants available on real mock-up and devices
  - A good inspector should have good skills to be able to adapt to different situations and interpret results
- Benefits of simulators: Educational tools
  - You can **see the invisible** and understand better:

    - Ray plot on section and 3D views to “see” sound paths,
    - Gate triggering displayed to understand beam/flaw interaction
    - X-Ray beam display



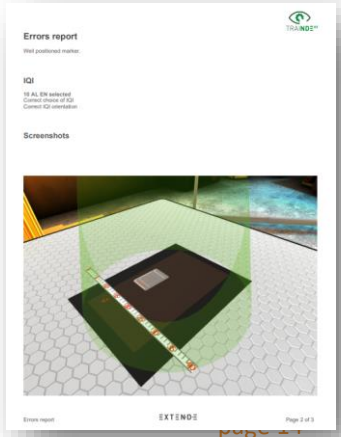


  - You can display the zone actually covered on the test piece
  - You can easily and quickly change inspection parameters and understand their impacts

Challenges and Benefits

- Limits of performance evaluation:
  - Instructor has to observe the inspection to give feedback
  - Accuracy is based on the experience of the instructor
  - Training hours limited to instructor's availability
- Benefits of simulators:

  - Session contents can be prepared in advance and customized for each trainee
  - Session and inspection parameters can be analysed and documented in a report
  - Users can get immediate feedback from the simulator and learn from their mistakes to self-improve themselves:
    - Errors report in RT
    - Visualize the flaw, compare with your own marking in UT



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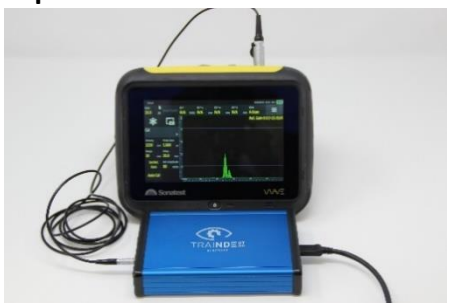
Challenges and Benefits

- Realistic ?
  - Indeed, simulators can not fully replace a real experience (no coupling, no real device to handle, etc.) but catch some of the main parts of it:
    Realistic probe handling, Source manipulation, realistic signals and images, realistic environment (Graphics, VR)
  - Trainees shall follow the “same process” as a real one to achieve a good inspection:
    - In UT: Calibration block/Sensitivity block/ Test block
    - In RT: Find relevant exposure parameters, select and position IQI and markers
  - Still possible to connect your virtual mock-up to a real UT Flaw detector (“Device Connected” option) to practice on your real equipment



TraiNDE: What's next ?

- Development roadmap :
  - TraiNDE UT:
    - Phased-Array applications
    - TOFD applications
    - Curved virtual mock-up
    - Online version for e-learning ?
  - TraiNDE RT:
    - Digital Radiography
    - Online version for e-learning ?

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Conclusion

- Simulators will not replace real experience but shows numerous advantages to efficiently initiate the training process (easy access, educational tools, work in //, etc.) and dramatically increase the practice time.
  - Such tools shall find their place to enhance the efficiency of the training process and proficiency maintenance
  - This tool is available as a standard on the shelf product:
    With TraiNDE, the future of training is … **now !**

- NDT workforce dramatically needs to attract young professionals. Such digital tools can play a role to help such people to integrate the NDT world !

- Want to see the system ? Come at the booth for a demo.

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Thank you !

- QUESTIONS ?

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