20th WCNDT 20th World Conference on Non-Destructive Testing
Songdo Convensia, Incheon, Korea, 27-31 May 2024

Mission and vision of Academia NDT International

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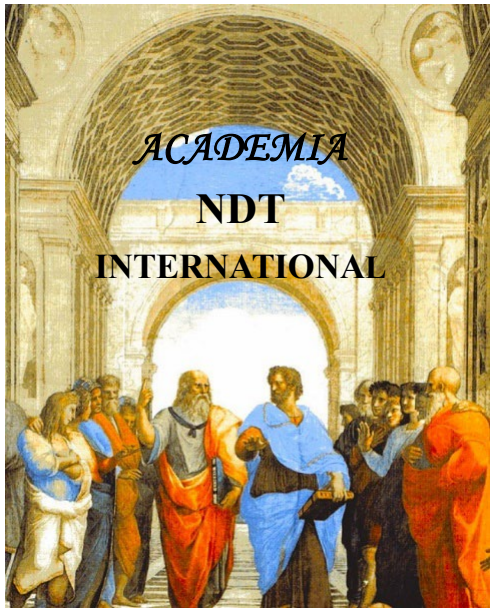
Abstract: The Academia NDT International is an independent, international, non-governmental and non-profit association of scientists. Its overall objective is to promote science, research, development and high education in the field of non-destructive testing/ evaluation (NDT/NDE) and technical diagnostics. The specific objectives of the Academia are (i) to provide a forum for exchange of ideas that brings together the most eminent scientists and experts of the world, (ii) to promote excellence in science and practice facilitating solutions to the problems facing mankind, (iii) to attract the attention of authorities, governments, agencies and public organizations to the role, importance and benefits of non-destructive testing/evaluation, and (iv) to support NDT societies and regional groups by transferring knowledge of the scientific and technological NDT achievements.
In the focus of Academia for the coming five years or so there are institutional, scientific, marketing and communication goals. In developing the Academia organization, our vision is to extend the aggregation of senior scientists and young researchers, to create special entrepreneur section, to establish a research laboratory network and to promote university program for NDT integrity engineering. The scientific vision is to operate a Scientific Council which should identify the key scientific questions and research tendencies in the field of NDT, would organise international research days in the large international NDT conferences and publish review papers or books on the scientific aspects of NDT development. The major marketing goal is to motivate industrial players to sponsor Academia. Within communication goals Academia intends to publish position papers on key issues and send them to academic and industrial sectors, and to visit laboratories to be up-to-date in research achievements and practical solutions.

Keywords: research, safety, NDE 4.0, NDT evolution, High education



Mission and Vision of Academia NDT International

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Academia International Research Day, 20th WCNDT

Incheon, Korea, May 29, 2024

Non-destructive testing / evaluation

- **Overall (most common) goal**

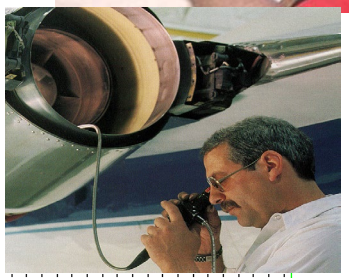
  Detection of **deviation** from condition suitable for use of (engineering) components / structures

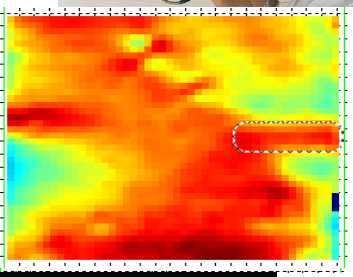
- ***Social driver – SAFETY***

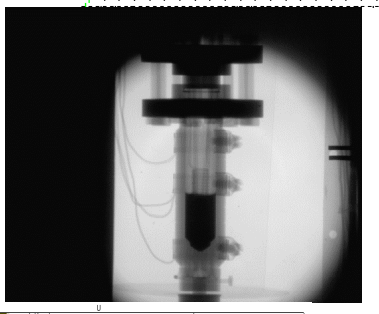
  Saving human, natural and built environment in case a structure fails due to non-detection of a flaw

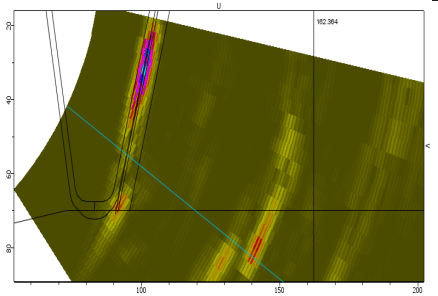
- ***Commercial driver – PRODUCTIVITY***

  Optimizing service life and performance of assets being inspected









Evolution of NDT / NDE

Pioneer period – Non-Destructive Testing (NDT)

- Quality control tool – *QC-NDT*
- Usual result: allowable / non allowable
- Dominance of standards
- Strong dependence on human factor
- Accepted despite unknown capability (solid design margin)

Recent past and present – Non-Destructive Evaluation (NDE)

- Quantitative requirements – *Q-NDE*
- Development in fatigue and fracture theory
- Paradigm shift in design concept (*safe life* → *damage tolerance*), sizing
- Performance based concept

Today and tomorrow – NDE 4.0

- Towards from ***„age of mechanization"*** via ***„age of information"*** to ***„age of intelligence"***

The bottom line

NDT IS NOT AN END BUT A MEANS

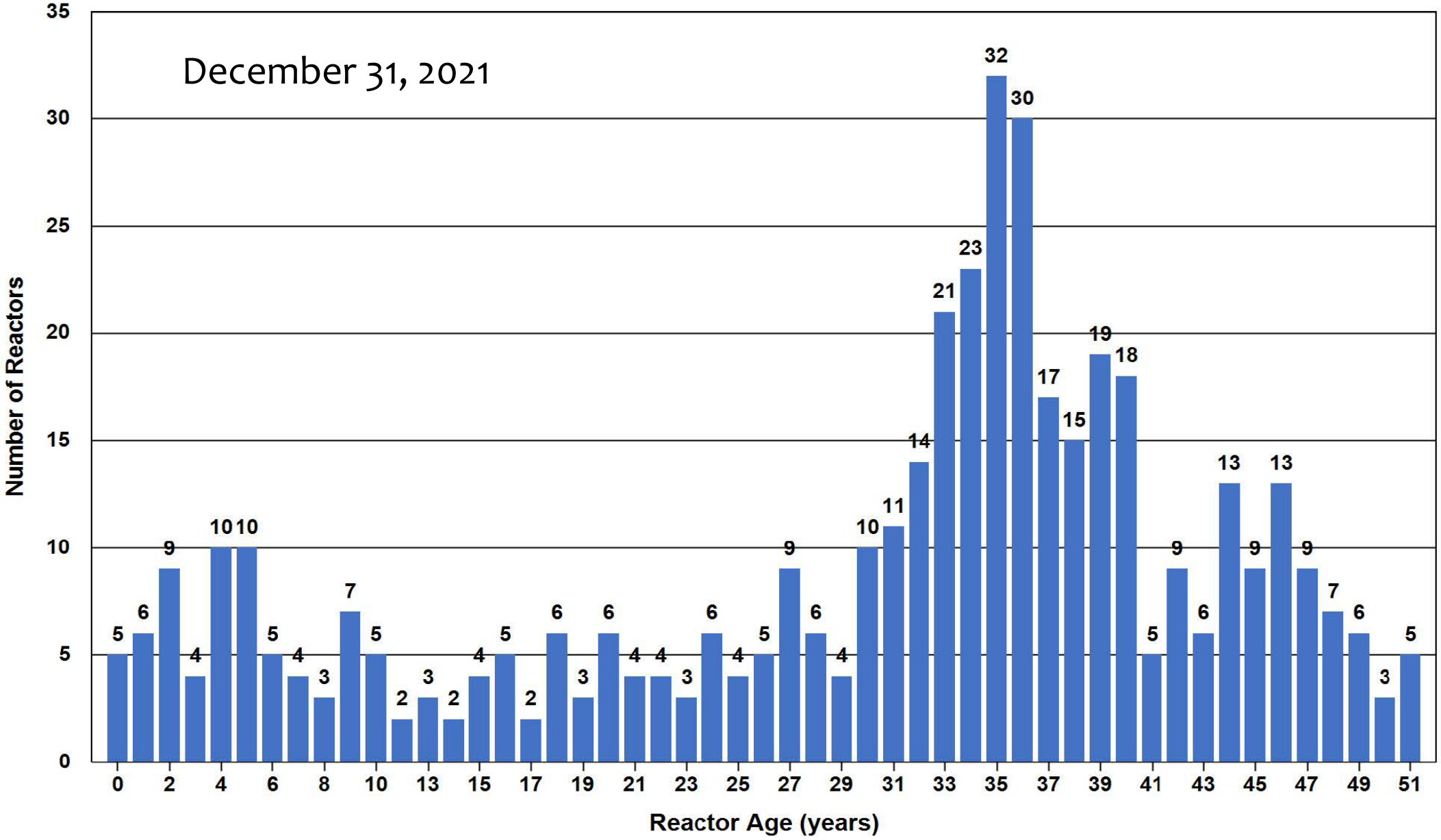
- *End:* **„the needs”** of the environment using NDT – *See social and commercial drivers*

- *Means*: **„the response”** of NDT community to fulfil the needs

TO ACHIEVE THE END, PROPER MEANS ARE NECESSARY

Means include: **equipment, procedure, human**

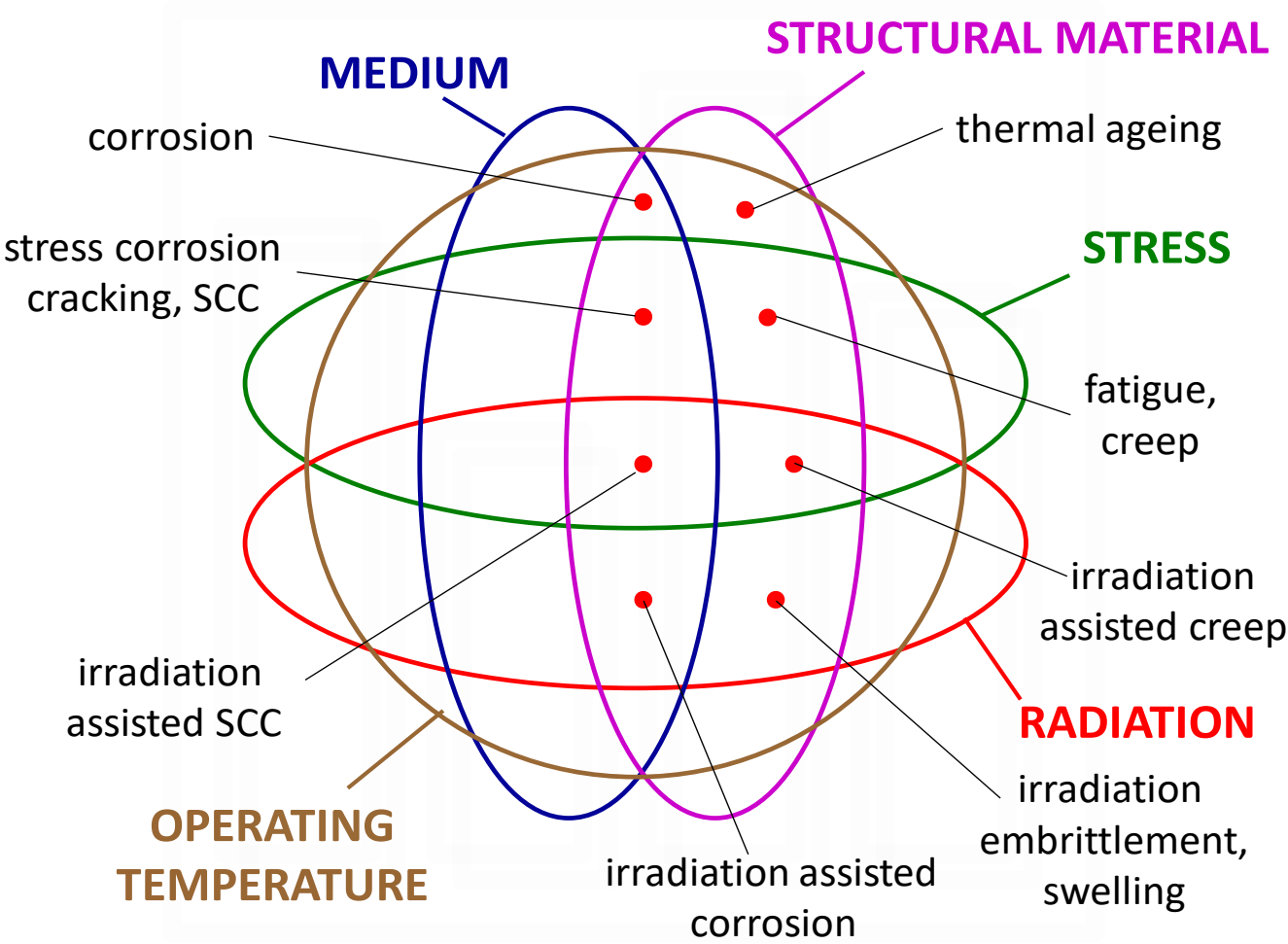
Example for needs analysis: *operating nuclear power plants*



Experiences challenging NDE in nuclear

- Austenitic welds
- Dissimilar metal welds (DMWs)
- Cast austenitic stainless steels
- Steam generator tubing
- Reactor vessel head penetrations
- Reactor internals
- Small bore piping

Especially in case of synergy effects (e.g. EAF, IASCC, …)



Response of NDT community

- Quantitative NDE
- Effective ISI / NDE
- Information technology, micro- and nanoelectronics
- Modelling, simulation
- New NDE techniques
- Novel methods
- NDE 4.0
- …

Quantitative NDE

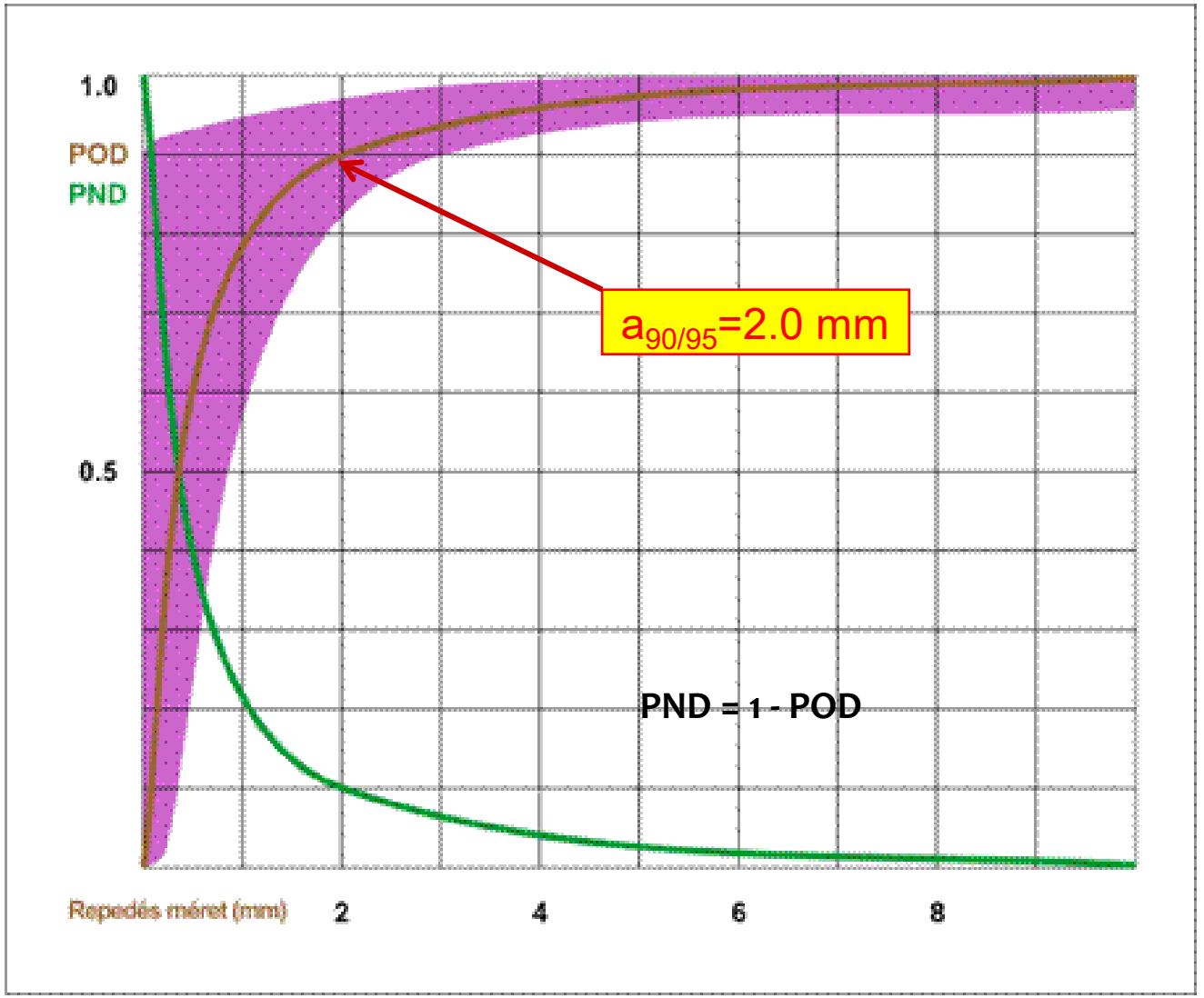
Q-NDE was born:

- Probability of detection (POD)
- PND = 1 – POD

NDE reliability:

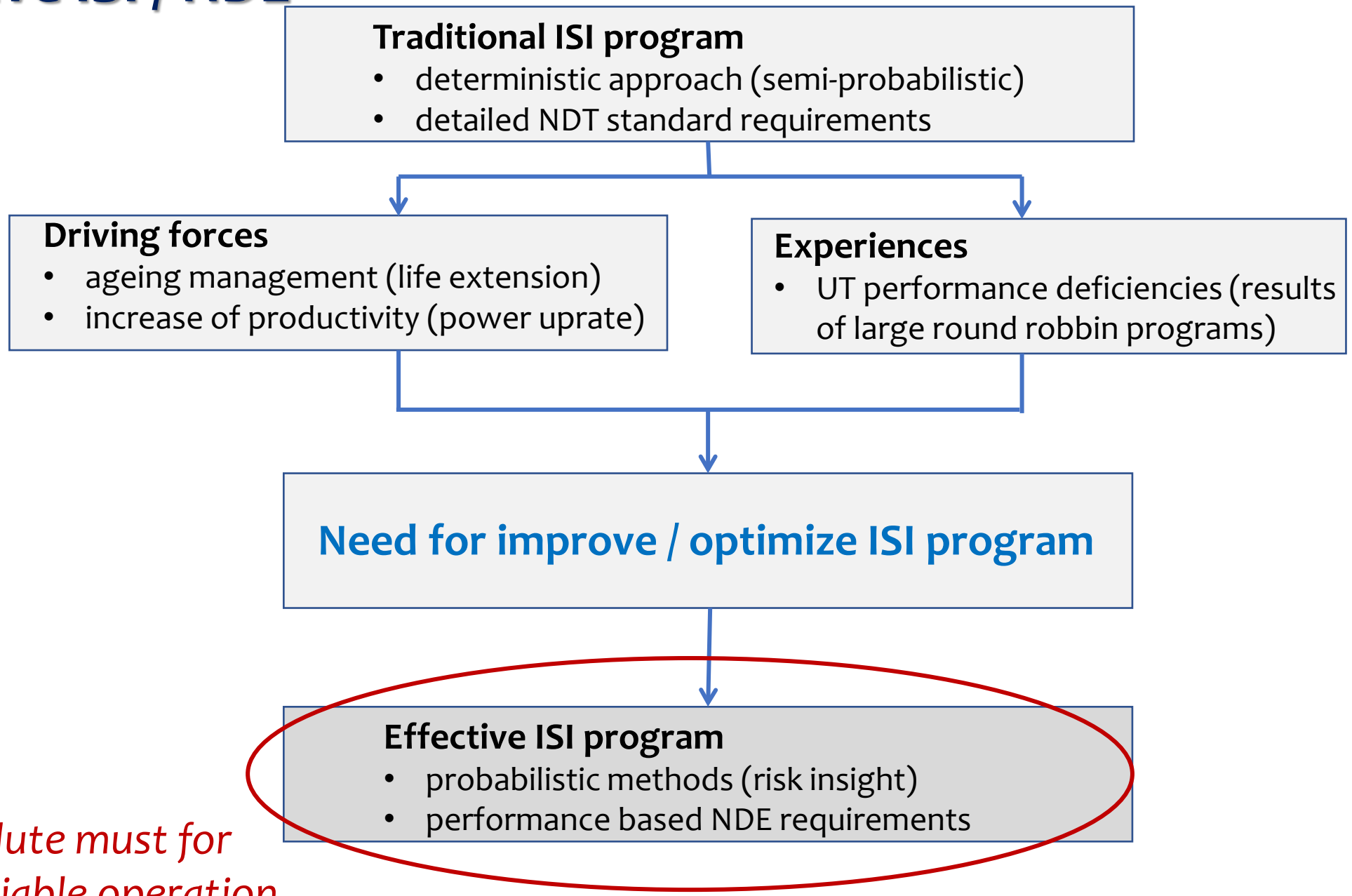
- applicability
- capability (POD)
- reproducibility
- repeatability

POD = Probability of Detection:
the fraction of detected flaws in the total number of all flaws,
as a function of flaw size



POD curve from the NASA space program, 1972

Effective ISI / NDE



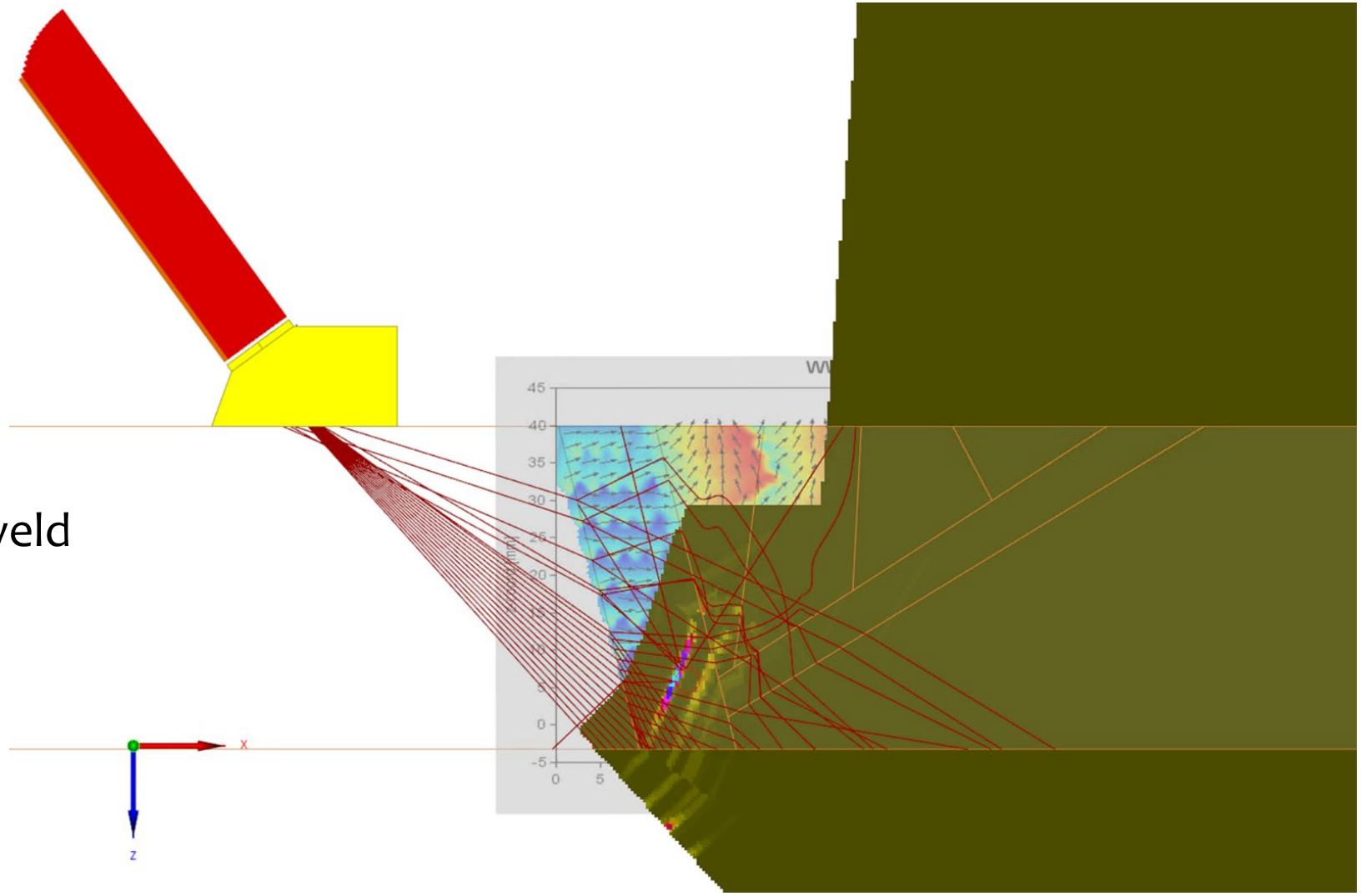
An absolute must for safe / reliable operation

Information technology, micro- and nanoelectronics

- Integration of different technologies
- Dividing line between sw and hw becomes indistinct
- Effects of quantum-physics are possible to measure *(sensor-in-chip)*
- Increase in sensitivity: instead of detecting flaw, proactive management of materials degradation (PMMD)
- Production: *real-time* automated inspection (goal: „flawless" condition)
- Operation: *on-line* monitoring (goal: ability for further operation, *FFS*)
- Structural Health Monitoring (SHM)
- Modelling and simulation
- 3D visualization
- Machine learning
- …

Numerical simulation – *Phased Array UT of DMW*

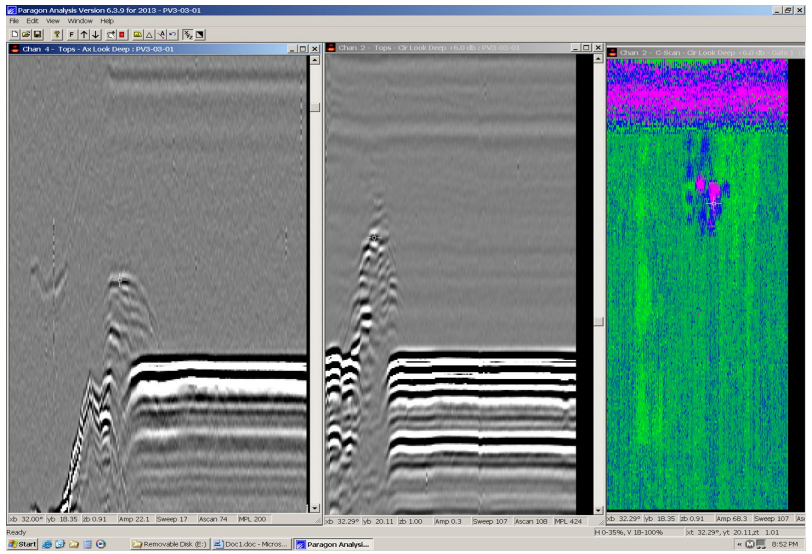
Including orientation of weld metal microstructure



Machine learning

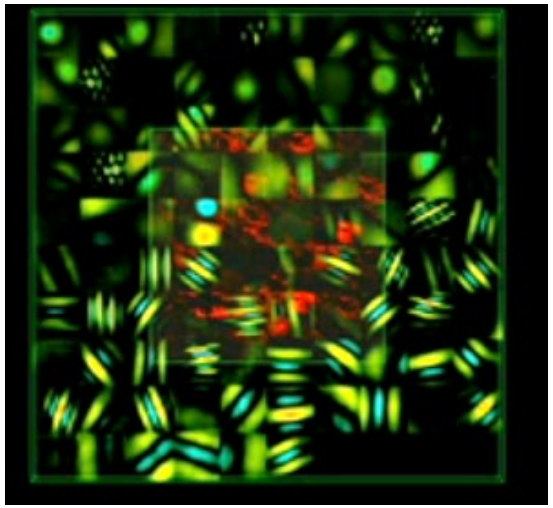
Algorithms processing big data effectively and quickly (AI)

Super computer

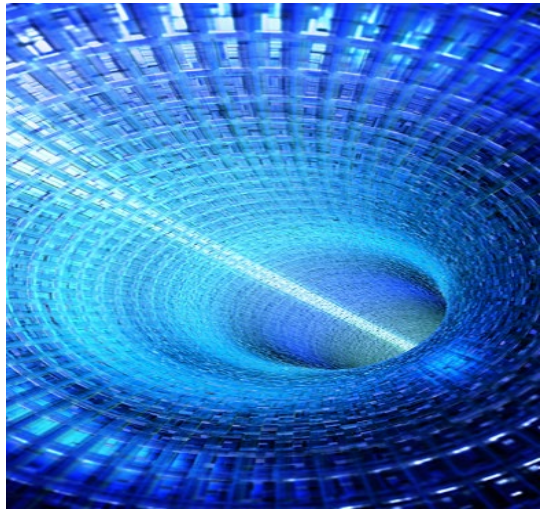


Processing UT data – ***from any techniques*** **– identification of flaws, noise, non appropriate coupling etc.**

Information processing in several layers → **artificial intelligence**



Big data (?) **Requires special procedure**

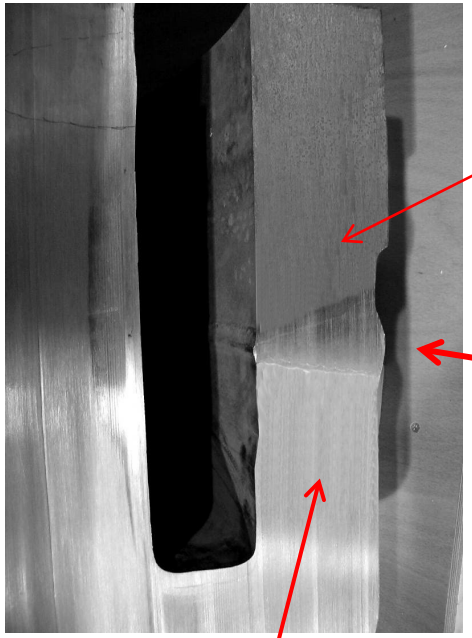


New NDT techniques

Examples only:

- Phased Array UT (PA UT)
- Full matrix capture / total focusing method (FMC / TMF)
- Time of Flight Diffraction (TOFD) UT
- Guided Wave Testing (GWT) or Long Range UT (LR UT)
- Electro magnetic acoustic transducer (EMAT)
- Computed radiography (CR)
- Digital Detector Array (DDA)
- …

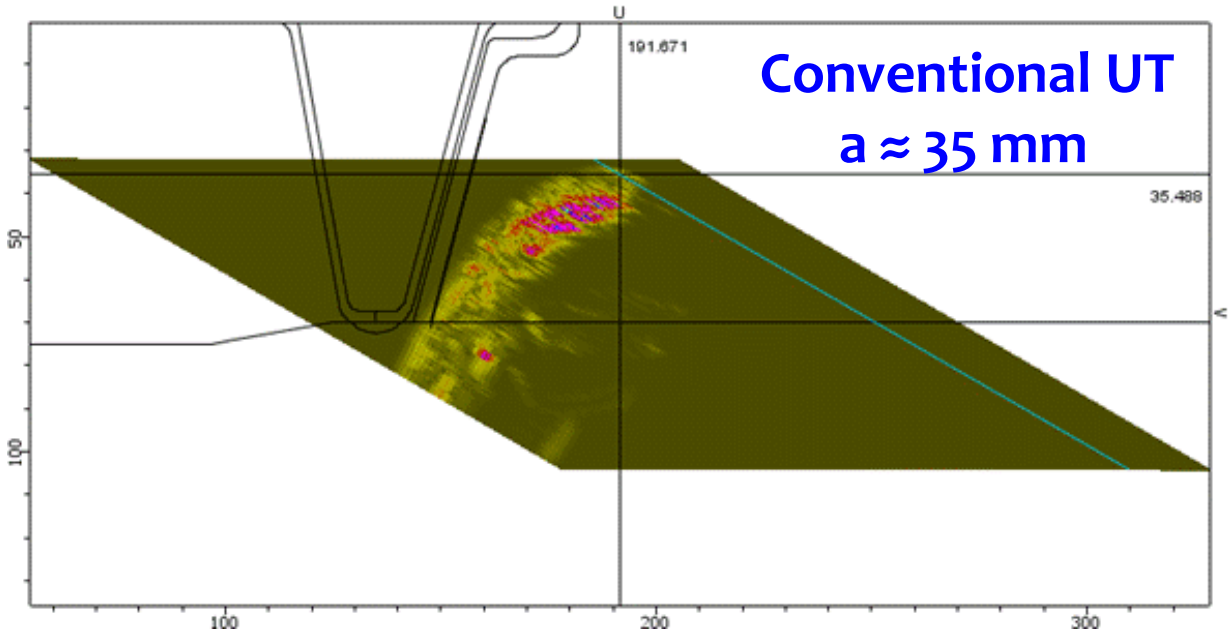
Example: dissimilar metal weld PA UT



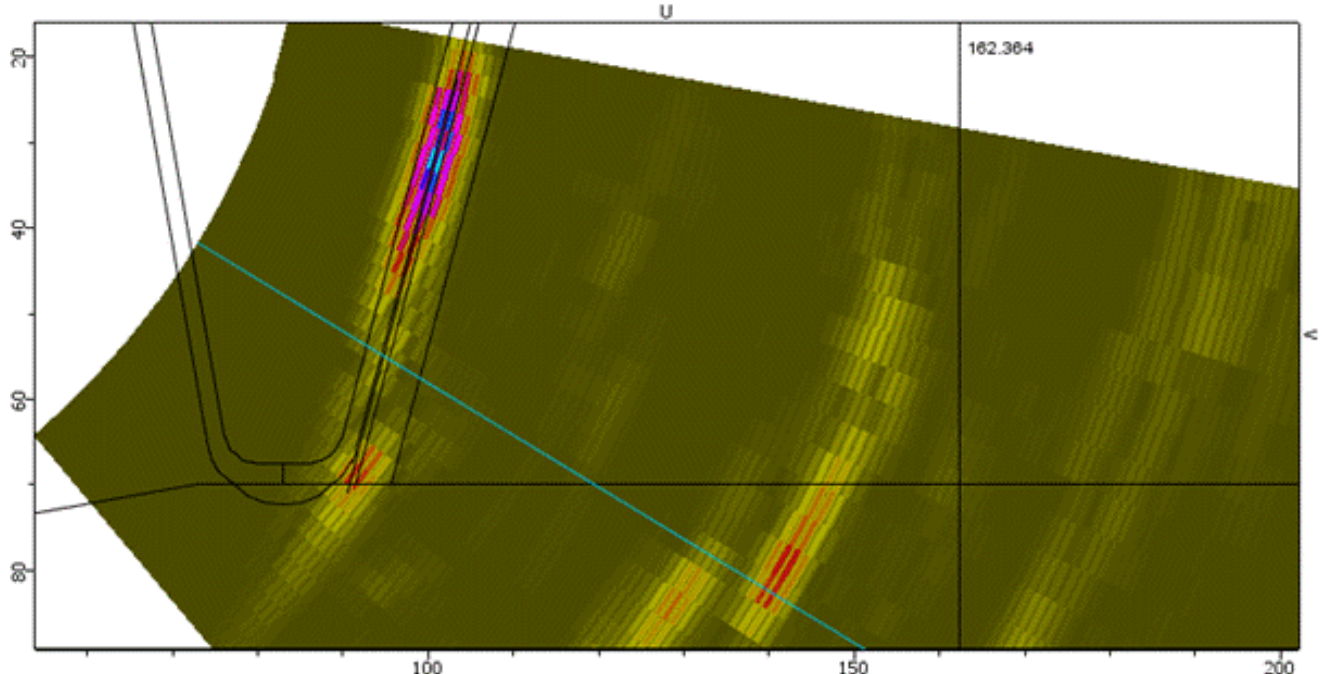
non-alloyed steel

DMW

stainless steel



Conventional UT
a ≈ 35 mm

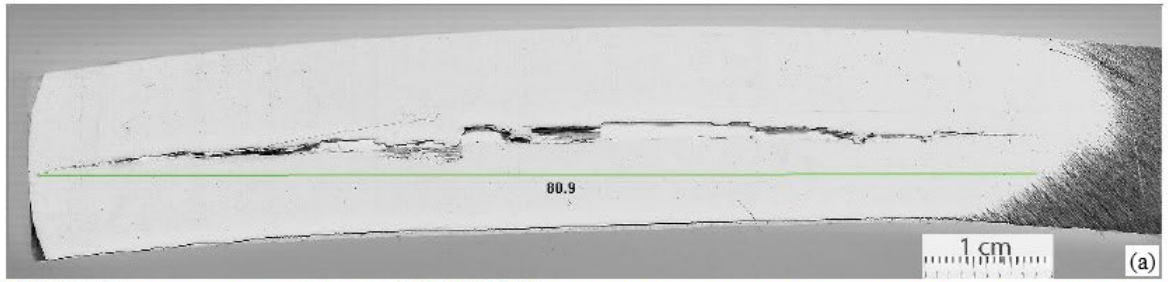


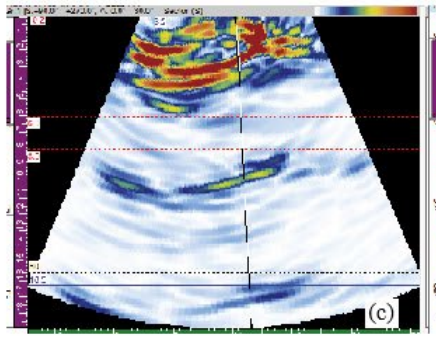
PA UT
a ≈ 49 mm
(wall thickness: 71 mm)

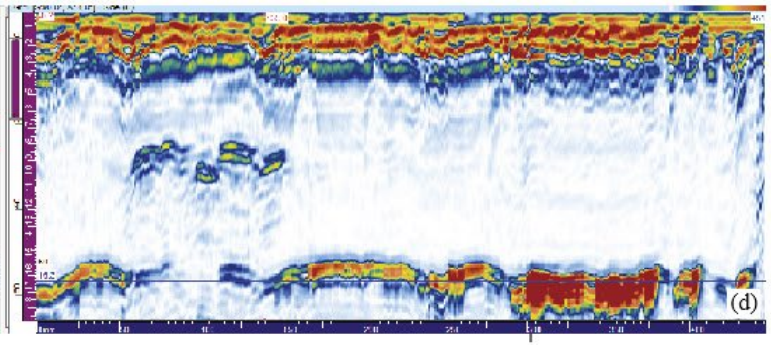
Same flaw!

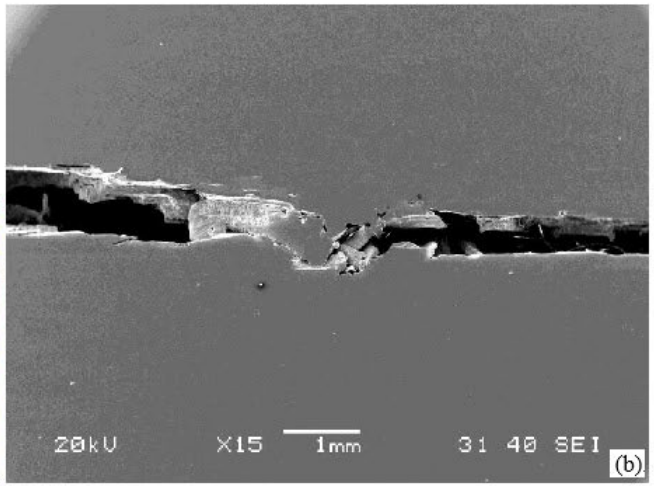
UT of hydrogen induced crack – *oil refinery pipeline*

„Traditional” PA UT

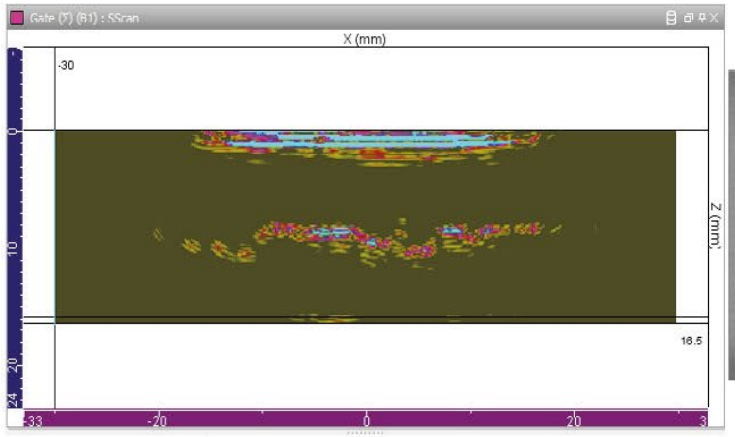


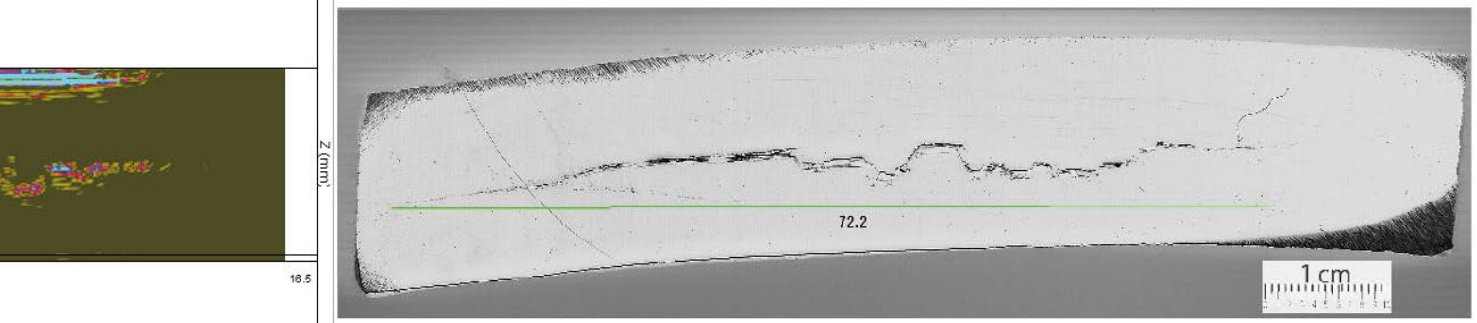






FMC / TFM





Novel methods

- Nonlinear acoustics
- Terahertz (3 GHz – 3 THz)
- Laser techniques (holographic interferometry, laser shearography,…)
- Dynamic thermography (mechanical, electrical, thermal exciting)
- Metal magnetic memory (MMM)
- Data processing, evaluation (artificial intelligence, neural networks, fuzzy logic)
- …

NDE 4.0

(what ?)

- cyber-physical NDE system,

(how?)

- created from merging of both the digital technology of Industry 4.0, the conventional NDE procedures and business model,

(why?)

- to improve the capability of inspection, the reliability of structural integrity assessment and of the quality / safety related decision making in general, and
- to provide data to the objectives of design, manufacturing, operation and maintenance

NDE 4.0 = Industry 4.0 + NDE

Paradigm shift – NDE 4.0

- **It is not a possibility, it is the necessity**
- Processing big volume of data, applying artificial intelligence
- Creating network of existing elements using instruments of the digital age and information to meet the future's market needs

  Attention: future's market needs are not equivalent with the current ones
- It changes the economy
- It changes the NDT / NDE itself
- It requires changes in many areas such as education and training of NDT personnel and engineers

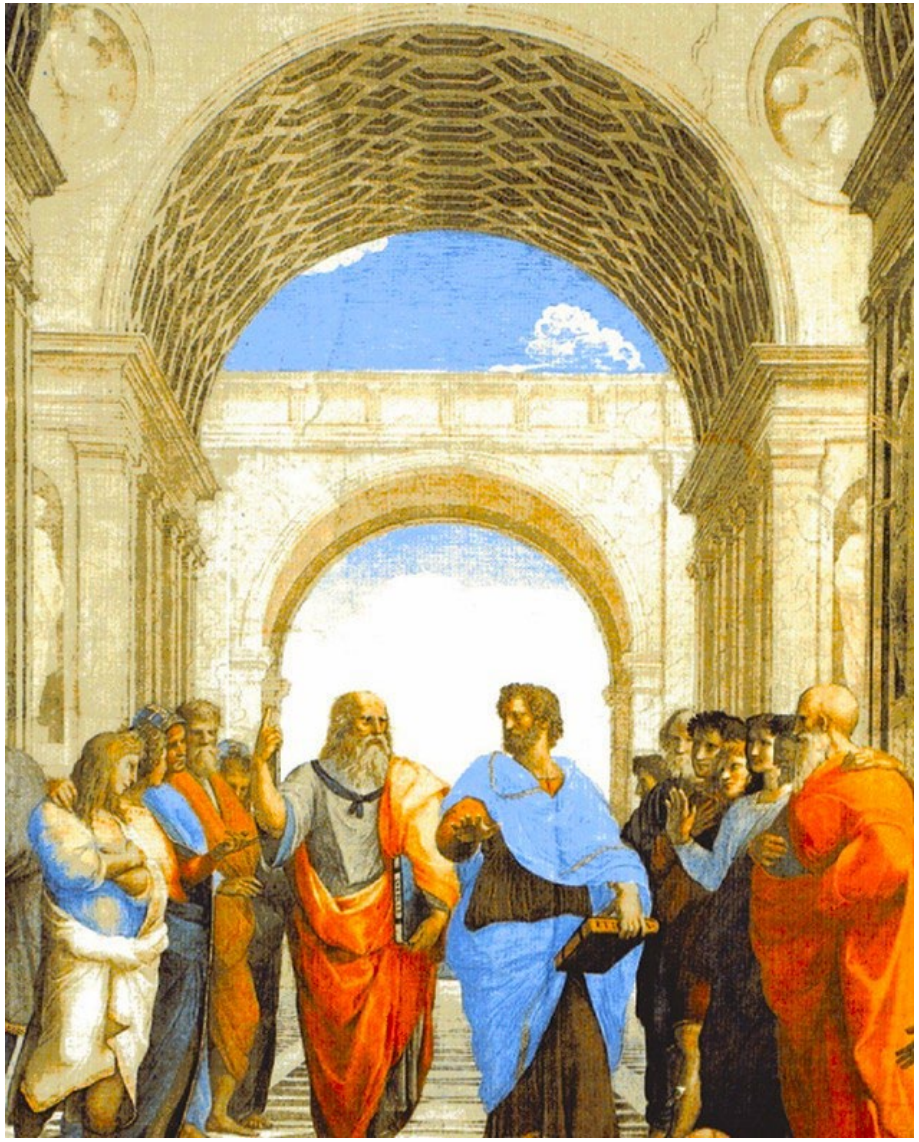
Academia – in ancient Greece

Academia was the term which described the sacred place in ancient Greece

where Plato is said to have had his Centre of Learning,

an olive grove dedicated to the goddess of wisdom,

Athena



Raffaello: The School of Athens (detail)

Academia – in these days

Academia represents an accumulation of knowledge in a certain field of science

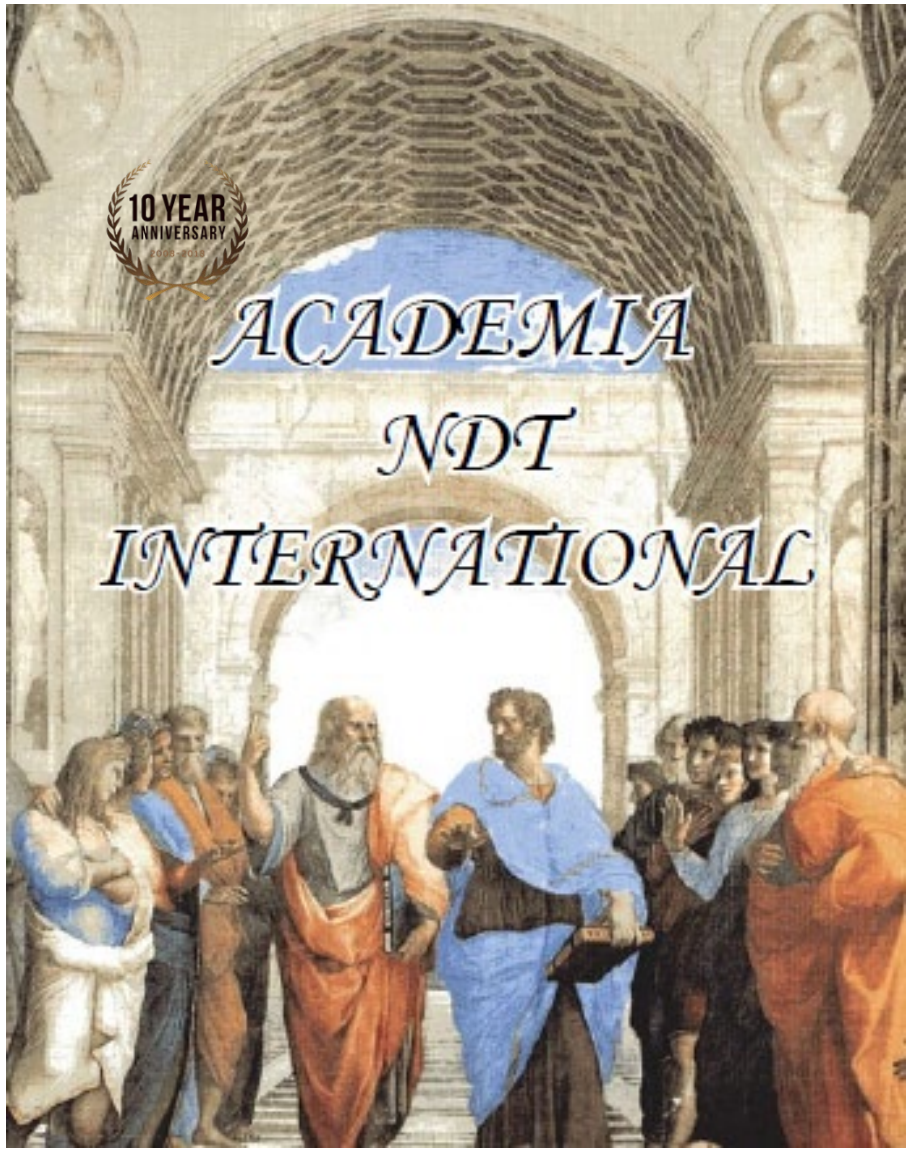
Academia brings together the most eminent scientists and experts with the goal to

- promote excellence in science and practice,
- facilitate solutions to the problems facing mankind

Academia NDT International

- Independent, non-governmental, non-profit association of scientists
- Established in 2008
- Headquarters: Brescia, Italy
- Members: 83 (end 2022)

- NDT / NDE people need Academia NDT International as the everlasting spirit for persistency in their work
- It is a highly motivated body to assure them a better professional life



www.academia-ndt.org

Academia's mission

- Promotion of science and R&D as well as encouragement of practical applications of findings in the field of NDT / NDE at universities, R&D institutions and other relevant bodies throughout the world by
  - providing forum for exchange of ideas that brings together the most eminent scientists and experts,
  - establishing and maintaining networks among scientists and technologists,
  - developing and contributing with a bank of knowledge, and understanding and implementing NDE philosophy, theory and practice,
- in achieving high performance materials and processes, and quality services,
- to attract the attention of authorities, governments, agencies and public organizations to the importance and benefits that NDE can provide

Academia's mission (*in broader sense*)

- Bringing together scientists who can bridge the gap between the technical and scientific disciplines and NDT / NDE
- This means either having basic expertise in related fields or being able to incorporate knowledge into NDE by transferring this basic expertise

Good practise:

Invitation of Nobel Prize Laureates to Academia International Research Day

Academia's vision (*for coming years*)

Institutional

- extend aggregation of senior scientists and young researchers
- create special entrepreneur section (*„from theory to applications"*)
- establish research laboratory network

Scientific

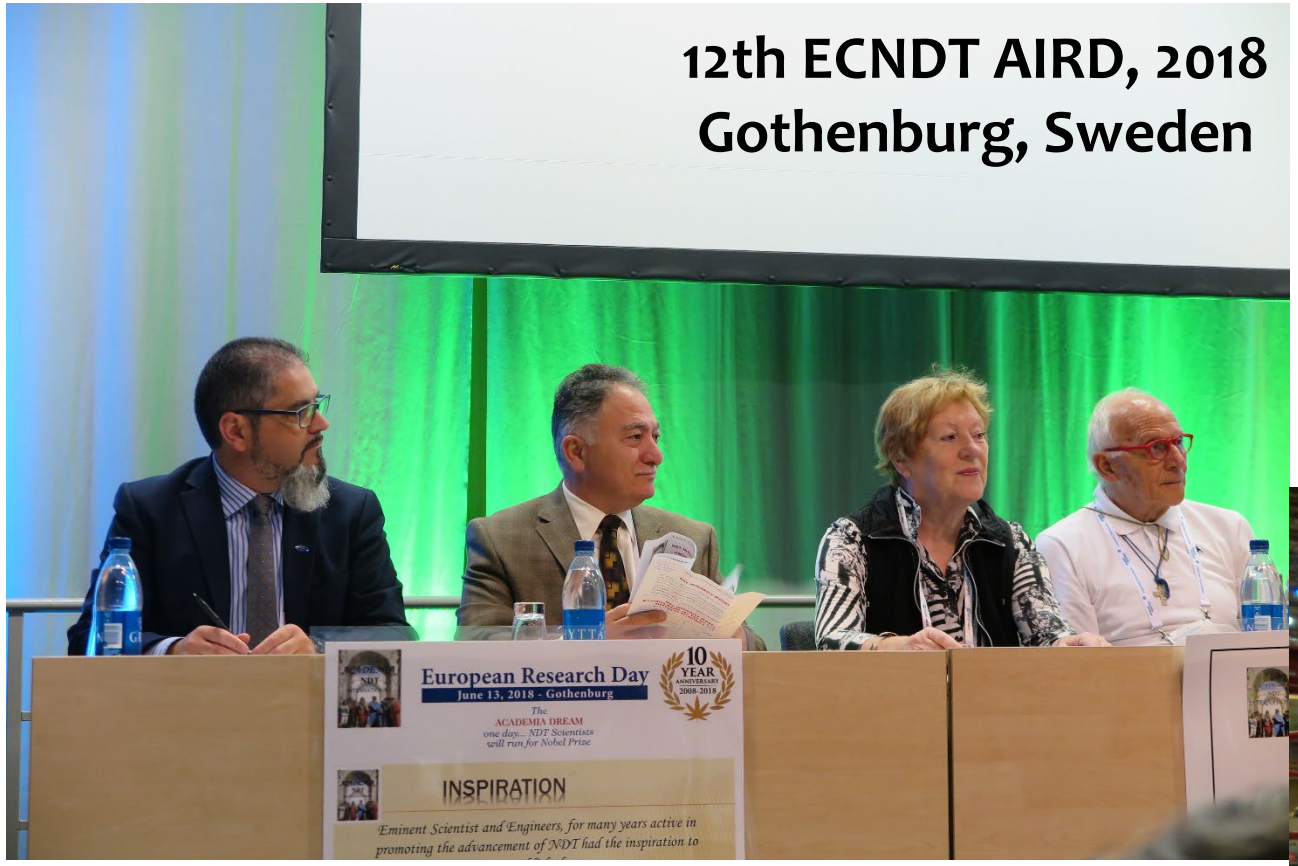
- identify key scientific questions and research tendencies in the field of NDT
- organise international research days in large international NDT conferences
- organize workshops in selected items
- publish review book(s) on the scientific aspects of NDT development
- promote university program for **NDT integrity engineering**

Marketing

- interact with ICNDT and regional NDT groups
- motivate industrial players to sponzor Academia

Communication

- publish position papers on key issues and send them to academic / industrial sectors
- visit laboratories to familiarize with research achievements / practical solutions



12th ECNDT AIRD, 2018
Gothenburg, Sweden

Nuclear plant visit, 2022
Paks, Hungary

Thanks for your attention!