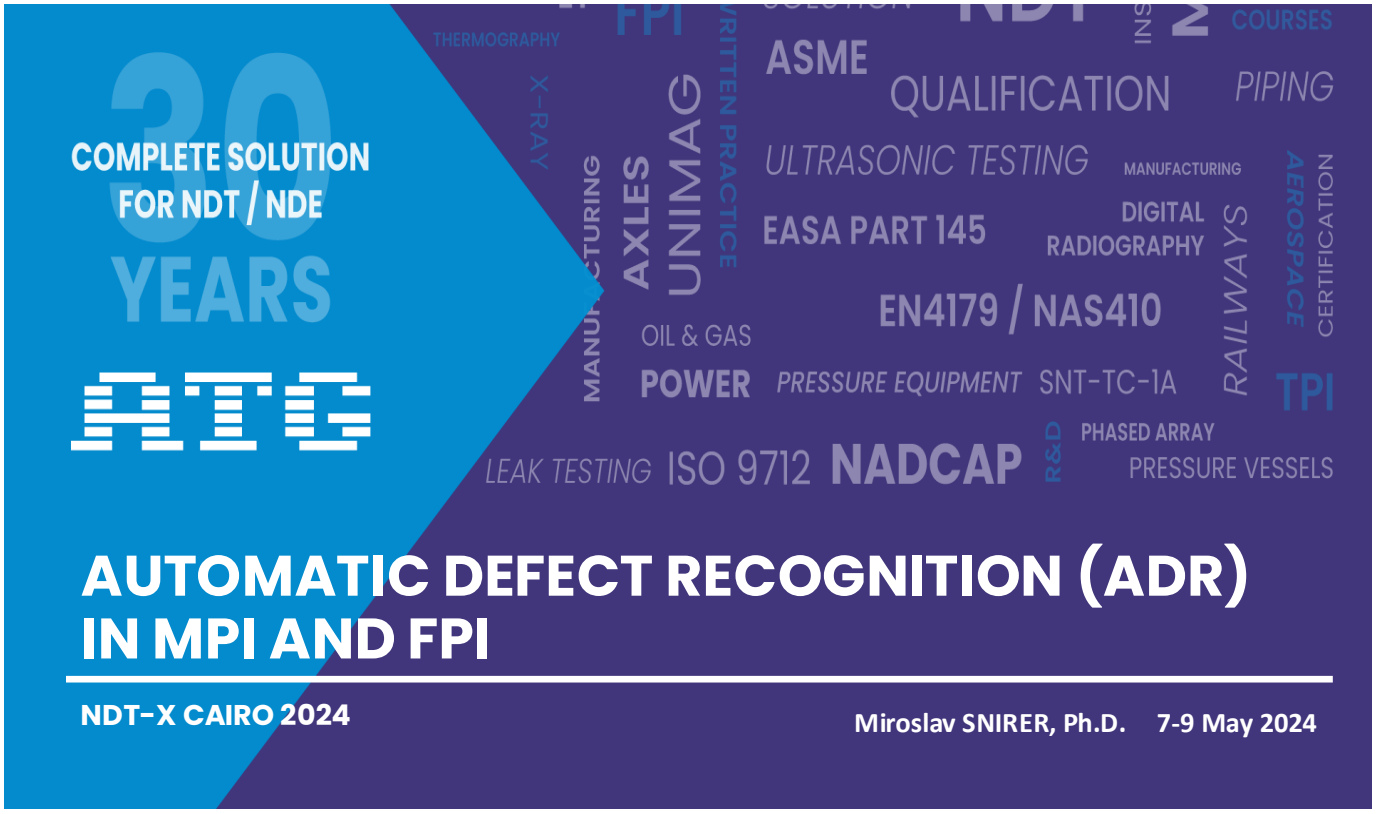
NDT-X CAIRO 2024
TECHNICAL CONFERENCE



AUTOMATIC DEFECT RECOGNITION (ADR) IN MPI AND FPI

NDT-X CAIRO 2024

Miroslav SNIRER, Ph.D. 7-9 May 2024

INTRODUCTION OF ATG GROUP

Advanced Technology Group s.r.o.

General description

- Privately-owned company based in Czech Republic
- Independent company
- Engineering company

Products and services

- Complete solution for NDT special process
- Products and services as two inseparable parts of special processes
- Global approach and integrity with international standards
- Advanced technology through strategic partnerships

Main areas of interest

- Europe (mainly Poland, Germany, Spain, France)
- All Russian speaking countries
- Turkey, Gulf area and North Africa
- East Asia (South Korea, Japan, Taiwan)
- USA

ATG GROUP PRODUCT PORTFOLIO

Advanced Technology Group s.r.o.

PRODUCTION OF EQUIPMENT

- Custom-made solutions
- Standardized equipment
- Consumables
- Supplemental processes

QUALIFICATION & CERTIFICATION

- Training and examination
- EN4179 / NAS410 standard
- Collection of experience
- Performance reviews

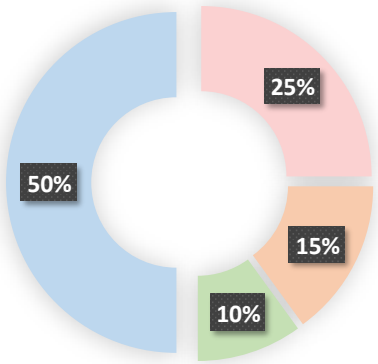
TESTING & INSPECTION

- Testing acc. EASA Part 145
- On-site inspections
- Special Process House
- Cleaning and cleanliness verification

CONSULTANCY

- NDT Level 3 services
- Design of the QMS
- Support for NADCAP / EASA audits
- Proficiency Testing

Product Portfolio



Equipment 50% Services 50%

ATG GROUP PRODUCT PORTFOLIO

Advanced Technology Group s.r.o.

PRODUCTION OF EQUIPMENT

- Custom-made solutions
- Standardized equipment
- Consumables
- Supplemental processes

QUALIFICATION & CERTIFICATION

- Training and examination
- EN4179 / NAS410 standard
- Collection of experience
- Performance reviews

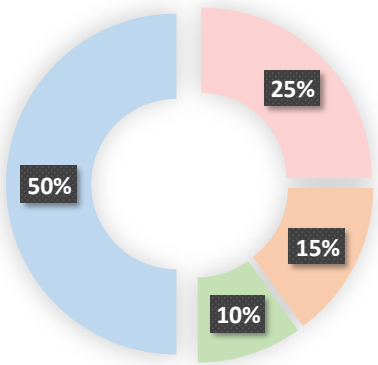
TESTING & INSPECTION

- Testing acc. EASA Part 145
- On-site inspections
- Special Process House
- Cleaning and cleanliness verification

CONSULTANCY

- NDT Level 3 services
- Design of the QMS
- Support for NADCAP / EASA audits
- Proficiency Testing

Product Portfolio



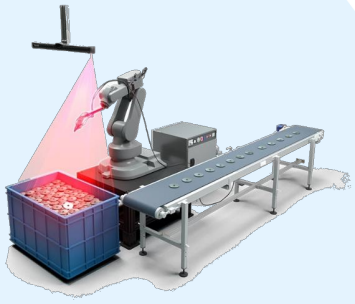
Equipment 50% Services 50%

RESEARCH & DEVELOPMENT
New automation trends in NDT

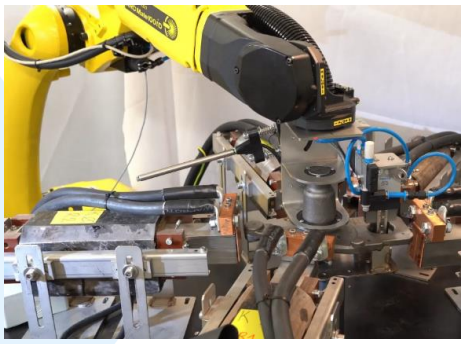
NEW AUTOMATION TRENDS IN NDT - MPI/FPI

Advanced Technology Group s.r.o.

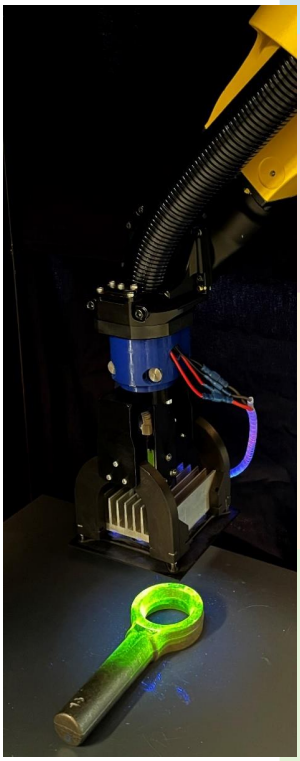
BINPICKING



MANIPULATION WITH THE PART



OR THE CAMERA

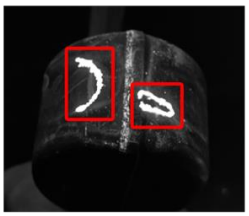


AUTOMATIC DEFECT RECOGNITION (ADR)

INDICATION

CAMERA

AI SYSTEM



WHAT IS ADR AND WHY DO YOU NEED IT?

Advanced Technology Group s.r.o.

Automatic Defect Recognition

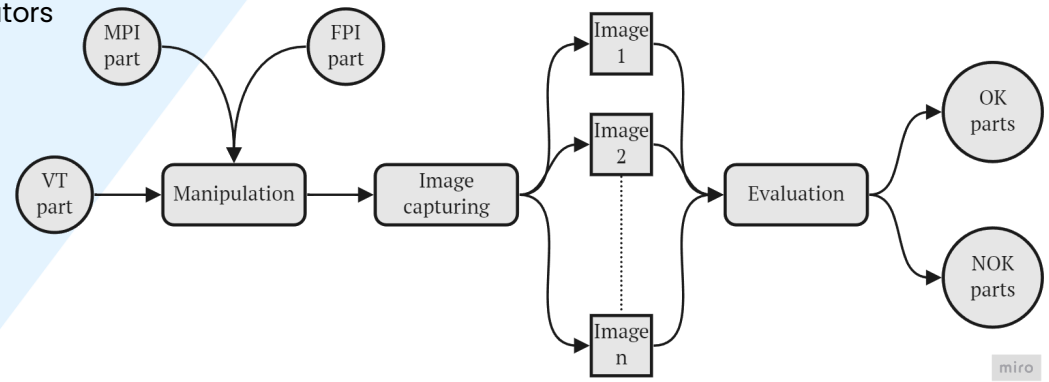
ADR based on AI (DNN), or classic image processing in special cases

- Captures an image of the object
- Recognizes relevant defects
- Evaluates the defects according to standards

ADR determines what is OK and what is NOT

Fully automated evaluation system replacing human operators

- MPI
- FPI

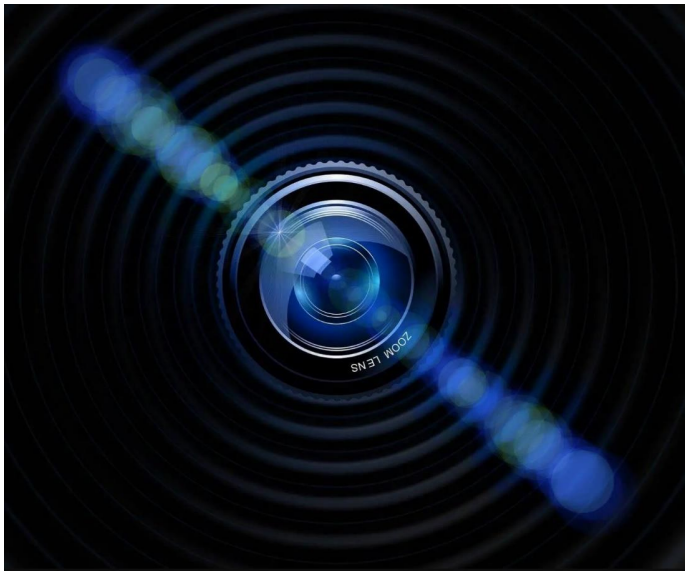


OPTICALLY-BASED VISION SYSTEM

Key feature to obtain evaluable image

Vision system

- Camera
- Lens
- UV light (ISO 3059)
- Appropriate optical filters
- Camera connected to computing hardware (GPU)



STARTS WITH DEFECT RECOGNITION

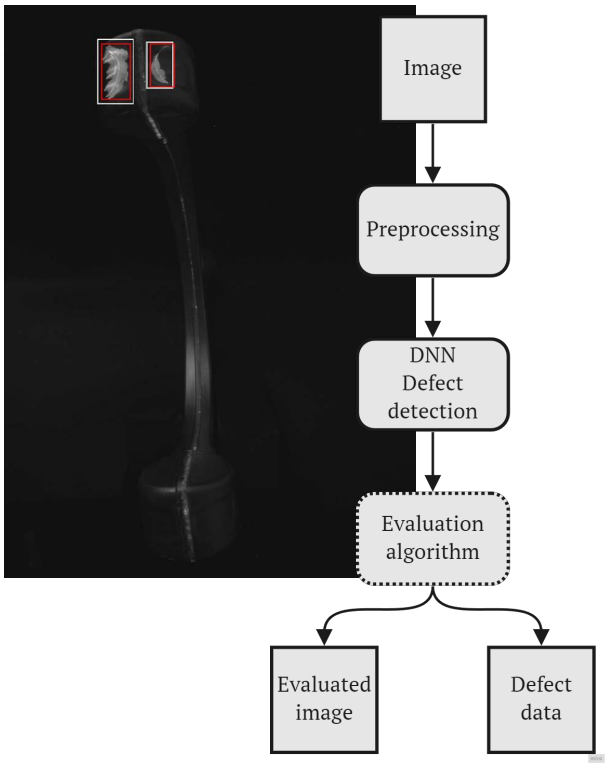
Finding indications in captured image

- Chooses most suitable neural network to recognize the indications
- Uses image processing to assist DNN

How to teach AI in the beginning

- Annotation of indications
- Training of DNN
- Creation of a small data set

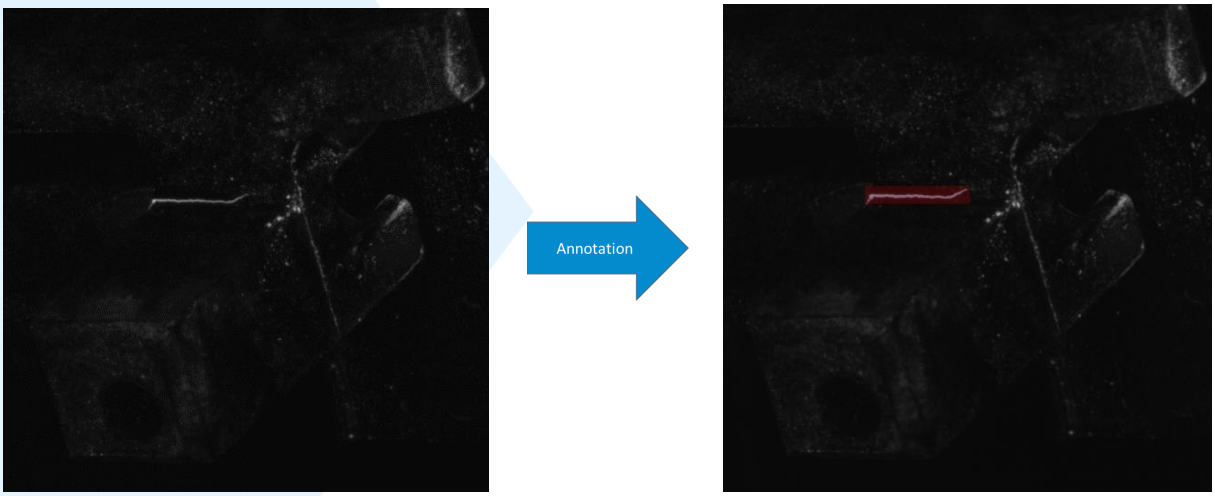
A small dataset leads to relatively low detection accuracy, but is enough for feasibility study



STARTS WITH DEFECT RECOGNITION

Advanced Technology Group s.r.o.

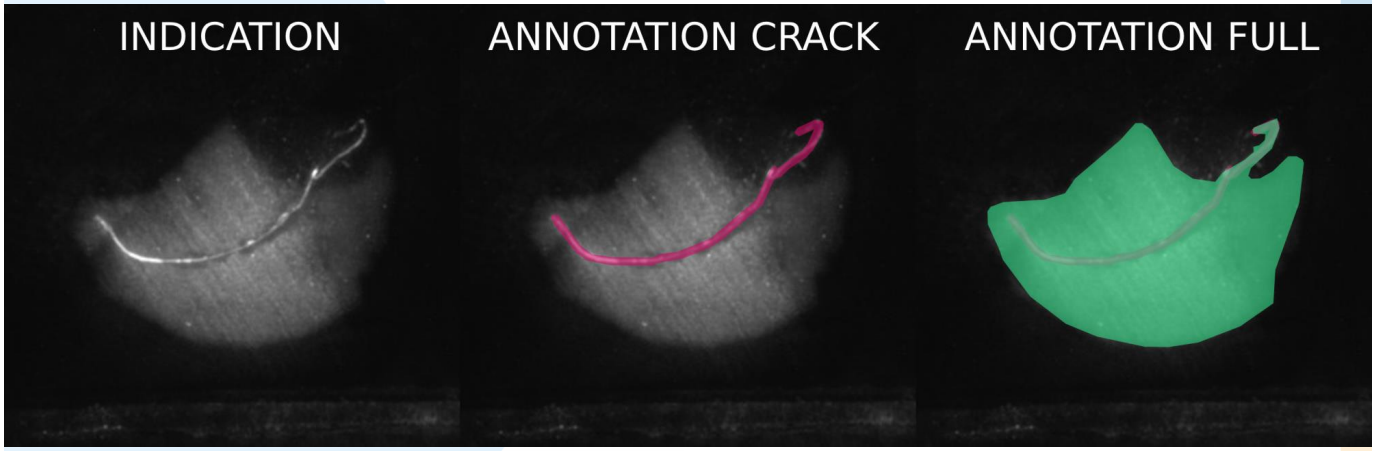
- Annotation of indications, e.g. MT



STARTS WITH DEFECT RECOGNITION

Advanced Technology Group s.r.o.

- Annotation of indications, e.g. PT



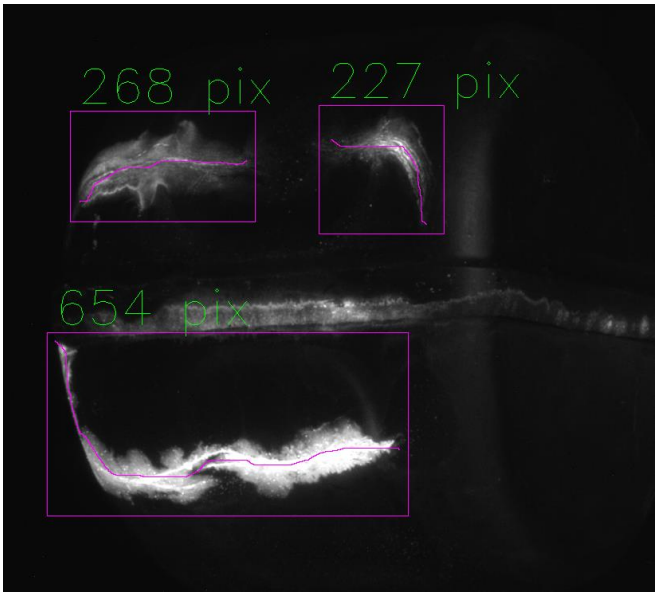
COMPLETION OF THE EVALUATION PROCESS

Achieving required result - high detection accuracy

- Long term process
- Necessary collaboration with the customer
- Getting the images on production site
- Retraining DNN several times
- Creating large dataset

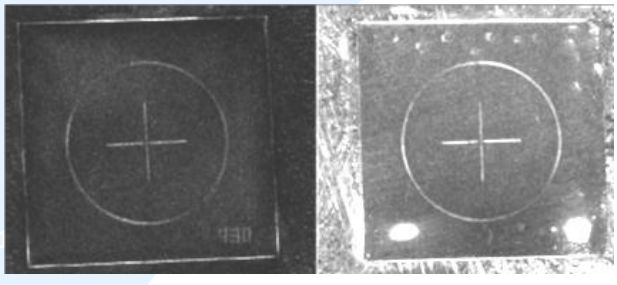
Process evaluation - algorithmization

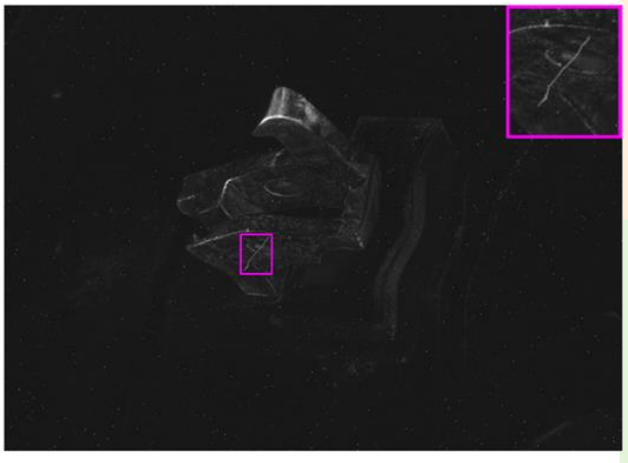
- According to standards
- According to requirements of customers



MPI/FPI ADR CHALLENGES

- Technical
  - Reflections (wet surface), false indications (edges), significant background...
- Economical
  - Large variety of tested parts and small series
  - Small number of samples, especially NOK parts
- Legal and liability – final responsibility still lays on Human factor!
  - ADR works typically like an assistant helping with fast defect detection, tracking and pre-evaluation
- Correct annotation
  - Needs experienced NDT professionel!



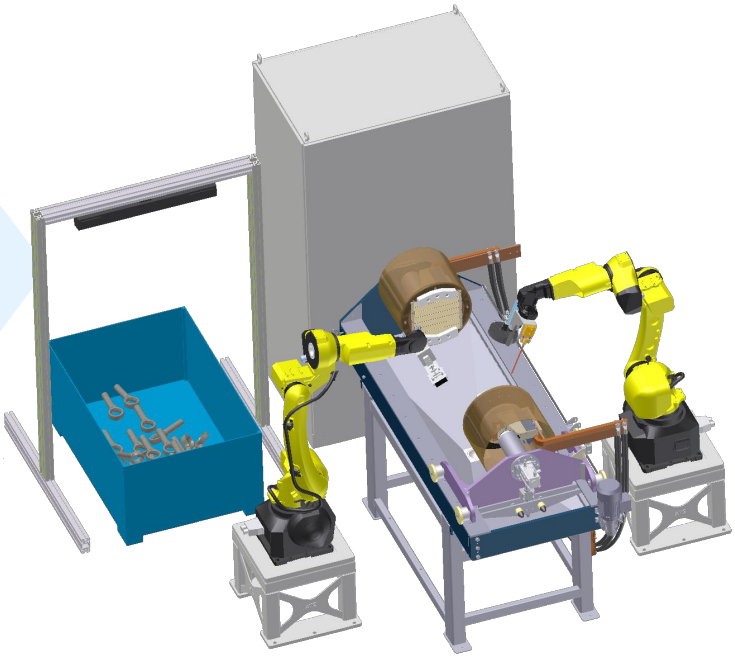


MPI/FPI GREATER AUTONOMY

- ADR/ROBOTS are just a part of **Autonomous systems**
- Other step to autonomy can be achieved by using our SOFTWARES e.g.
  - TEST PLAN PRO incl. WI, DCM Code/typing for MPI
    - WI – clear visual information „how to magnetize part" when operator is needed
    - Automatic system setting and testing
  - Customized SCADA (typically for FPI)
  - CONNECTION TO MES, or ERP (this quite standard)
  - All this brings also reliable traceability of the NDT process
  - Next possibilities for greater systems autonomy:
    - Remote calibration,
    - automatic self tests on ref. parts,
    - self diagnostic of UV lamps,
    - or suspension/penetrant status,
    - checking material structure by ET
    - automatic checking of MT intensity on the parts

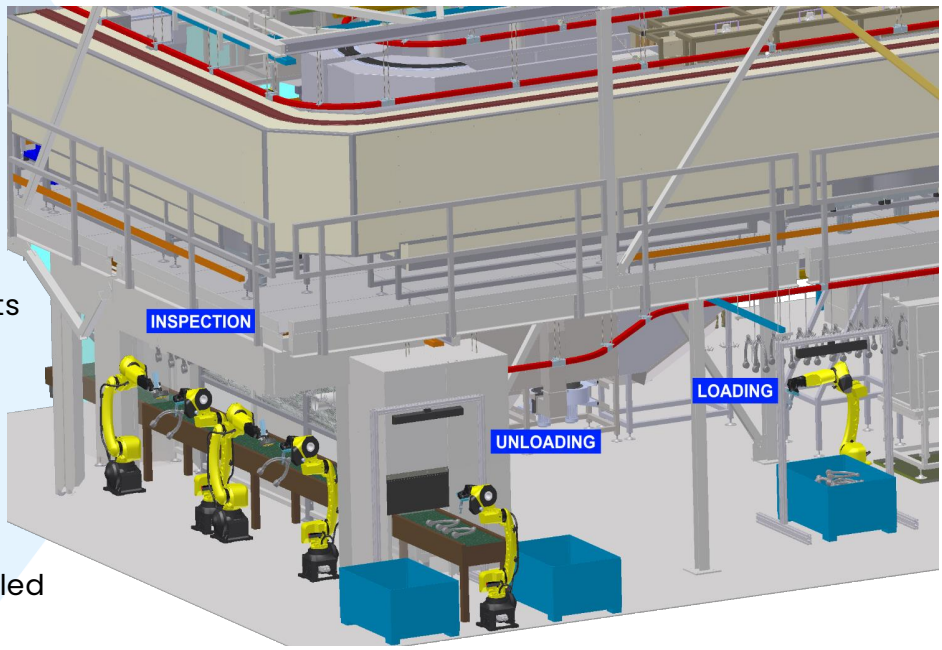
EXAMPLE OF FUTURE FULLY AUTOMATIC MPI

- ADR of MPI indications
- Camera / UV light handled robotically
- Bin picking of parts
- Automatic calibration
- Magnetic field intensity measurement
- Diagnostics
  - UV light
  - Camera
  - Magnetic suspension
- Comprehensive reporting system
- Remote access supported / enabled



EXAMPLE OF FUTURE FULL AUTOMATIC FPI

- ADR for FPI indications
- Parts handled by robot
- Inspections done robotically
- Automatic calibration
- Bin picking of parts
- Diagnostics
  - UV light
  - Camera
  - Rinse water
- Comprehensive reporting system
- Remote access supported / enabled



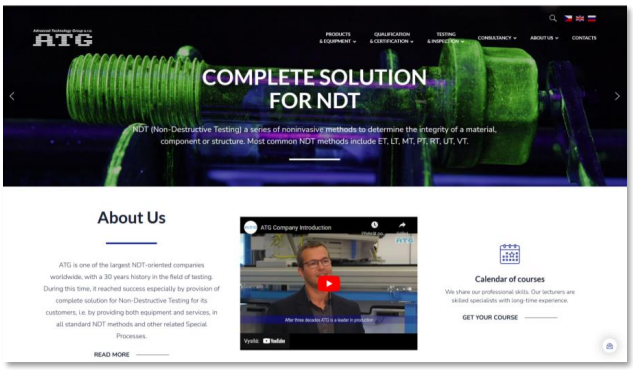
KEY BENEFITS OF ADR

- Increases repeatability and consistency of evaluation
  - Reduction of operator errors
  - Elimination of carelessness
- Improves process efficiency
  - Saves manpower
  - Lower inspection cost
- Facilitates higher process productivity
  - 24/7 operation
- Archivation of documented indications
  - Tracing

CONTACT INFORMATION

Miroslav Šnírer, Ph.D.
Research & Development
Vision Systems Specialist

ATG - Advanced Technology Group
Toužimská 771, CZ - 199 02
Praha – Letňany, Czech Republic
Email: snirer@atg.cz , Web: www.atg.cz



LinkedIn YouTube