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The beginnings of TTP at the Military University of Technology (*Wojskowa Akademia Techniczna*)

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MUT as a military institution = unique context and reality

The main goal of the university was to teach – but the specificity of R&D projects, outsourced to the MUT by the Min. of National Defence, was the requirement that the main components of designed devices were either a domestic production or should come from other member countries of the Warsaw Pact.

And in the 1970s:

- Armies outside the Warsaw Pact already had a wide and fast growing family of different types of thermovision cameras (based on 1D or 2D multielement detectors, only), called "FLIR" back then.

- All elements of IR techniques were under strict embargo.

- In Poland we **didn't** have neither proper photon detectors nor the knowledge of "Infrared Systems **Engineering"; we** also did not possess adequate measuring stations or military thermal cameras to be used e.g. as learning patterns.

Example:
Raytheon Comp./USA/

AGA 680 was the benchmark model for civilian cameras - for us at MUT the benchmark was:

FLIR = „Forward Looking Infrared” (1970s)

History of FLIR began in 1963 when Texas Instruments' Defense Systems and Electronics created a capability to essentially allow the warfighter to see at night. By the end of the 1960s, the first product had been developed and deployed on board a C-47 fixed wing aircraft, nicknamed "Puff the Magic Dragon."

From that first platform, and after five decades, hundreds of thousands of devices have been sold by Ratheon only (!).

At the beginning, these devices were based on 1D, in 1980s on the 2D arrays of IR photon detectors (deep cooled) emerged, in 1990s and later on thermoelectrical and lastly uncooled arrays of detectors (as well as on applications).

These devices are used on land, air, water, and in space to provide intelligence, surveillance, navigation and targeting capabilities.

WG: http://www.raytheon.com/capabilities/rtnwcm/groups/gallery/documents/image/flir_infographic.png

MUT projects related to thermal imaging (in the 1970s)

Two directions/focuses:

- creation of photon detector (CdHgTe = MCT and PbSnTe) technologies,
- academic teaching and designing of equipment for military and civilian programs.

DETECTORS at the Faculty of Chemistry and Technical Physics

- Understaffed team with little funding has created both apparatus and process technology from scratch.
- Main efforts focused on single and uncooled detectors – real ”news” in MCT technology but, as assumed (properly) good enough for laser beam detection (!)
- 1978 – the team began a program to develop a 16-line elemental cryogenically cooled detectors CdHgTe - ordered for our thermal cameras.

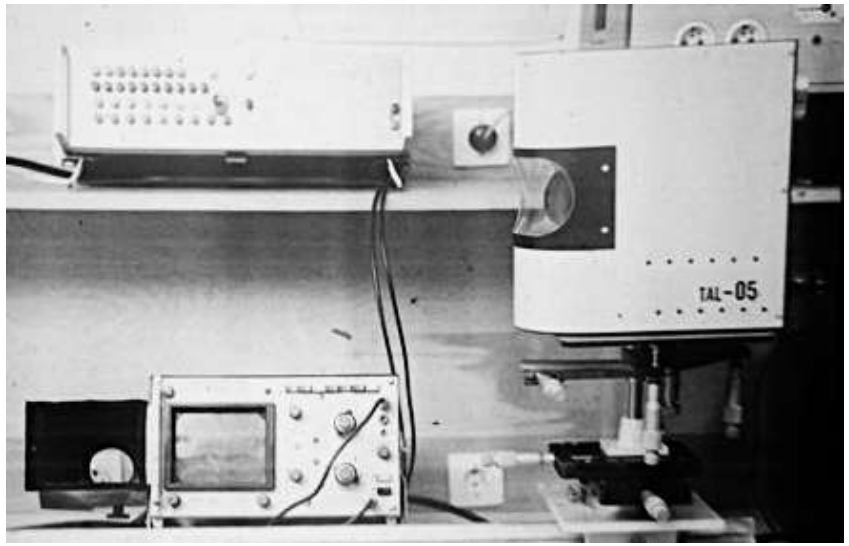
MUT projects related to thermal imaging (in the 1970s)

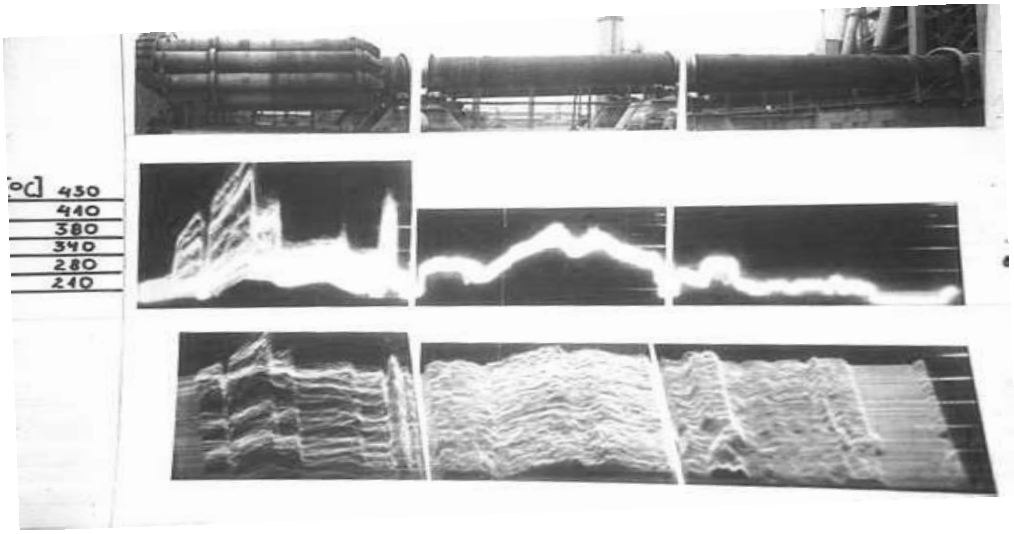
PROMOTION OF IR TECHNIQUES AND TEACHING – MUT Department of Electronics

- 1970-1972: Publication of the academic script called "Medical thermography".
- 1972-1975: Works on the use of liquid-cholesterol-crystals for medicine and industry ("camera").

- 1975 -1978: Establishment of the MUT Department of Thermography, with Dr. G. Rudowski as the first Head of Department. Task: to create a didactic/research & construction base for military IR technology. It led to creation of the first labs and „self-improvment" programs in „IR Systems Engineering".
- 1978 -1979: An educational program was initiated and many diploma projects were completed. Started works under preparing a new specialization study in MUT: "Optoelectronics". Due to the backwardness of Polish technology, proposals for IR dedicated „big & long national program", have been elaboarated (and implemented, in part, in 80's).
- Our designing was based on uncooled/low cooled MCT PC MW single detectors only → therefore it was limited to models of simple IR linear scanners. <u>Not suitable for the army!</u>

An example of our TAL-05 (TermoAnalizator Linii, 1978) :





Development without significant duplication (despite industry interest, after multiple-site tests and open presentations). The reason? „Too fast degra-dation of parameters of those, uncooled, CdHgTe PC detectors (2-4.5) μm”

Our **MILITARY devices in the 80’s:**

- ”STAL” scanner (with extreme requirements for military jet), but the work was not completed due to lack of 1D(8 el.) MCT detectors;
- „Thermal camera” for the tanks – also stalled due to lack of 1D or 2D detectors.

...but today MUT provides:

- Specialized education (M.Sc. Eng, or Eng. offered to military and civilian students)
- Research, construction and certification (for military and non-military customers)

Thanks to:

- Unique laboratories for measurement, experiments and research
- Set of high-resolution thermal cameras (for SW, MW, LW)
- Set of Fourier Imaging spectroradiometers (for MW, LW)
- Very professional team (22 members, including a Full Professor and 12 Ph.D.'s)
- Decades of accumulated experience

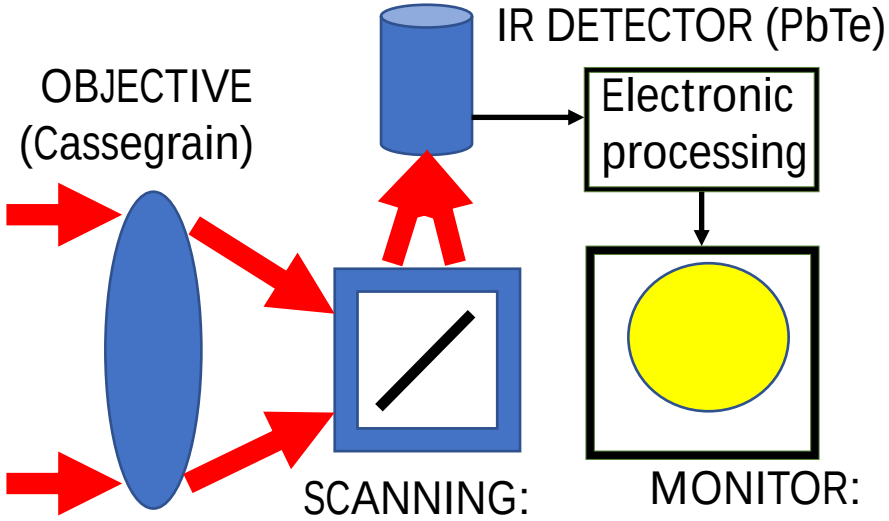
Head of ZTPiP Department (in IOE MUT)
Prof. dr hab. inż. Henryk MADURA

http://www.ioe.wat.edu.pl/data/zalaczniki/_broszury/ZTPiT_pl.pdf

The first Polish thermographic cameras made by Dr. Grzegorz Rudowski's team (Warsaw University of Technology, 1968-1975)

- Goal: IR detector & optics made in Poland (i.e. at WUT)
- Development: Several models, 3 cameras delivered to research institutes

Key design features:



SCANNING:
1mirror unit:
Hor. - fast
Ver. - v. slow

MONITOR:
(oscilloscope)
1 frame == 1 min.
About 50 lines
$\Delta T < 2^{o}C$

Optical system: A.Szwedowski, Ph.D - Optics Dept.

IR detector; in dewar; designed by Rudowski's team

Tablica 2

Parametry fotoprzewodnościowych detektorów PbTe chłodzonych ciekłym azotem, stosowanych w termografach I.T.E. Politechniki Warszawskiej (500 K, 500 Hz, 1 Hz)

Symbol detektora	Czułość $\frac{V}{W}$	*NEP* $\frac{W}{Hz^{1/2}}$	*D** $\frac{Hz^{1/2}\,cm}{W}$	τ µs	*R* MΩ
DP-245-41	16 000	$1{,}8 \cdot 10^{-11}$	$3{,}5 \cdot 10^{9}$	20	20
DP-255-65	17 800	$1{,}63 \cdot 10^{-12}$	$3{,}68 \cdot 10^{10}$	15	0,35
DP-255-70	10 700	$2{,}7 \cdot 10^{-12}$	$2{,}22 \cdot 10^{8}$	40	4,5
DP-445-126	77 000	$6 \cdot 10^{-13}$	$1 \cdot 10^{11}$	—	0,65

τ — stała czasowa detektora
R — rezystancja warstwy czułej