

# **Thermal Sensation Threshold of Millimeter Wave in Japanese**

**Period: 2015 – 2017 (plan)**

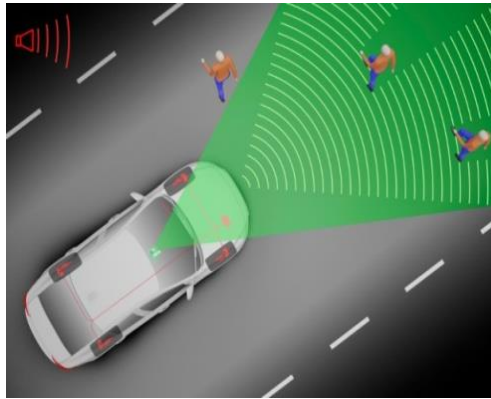
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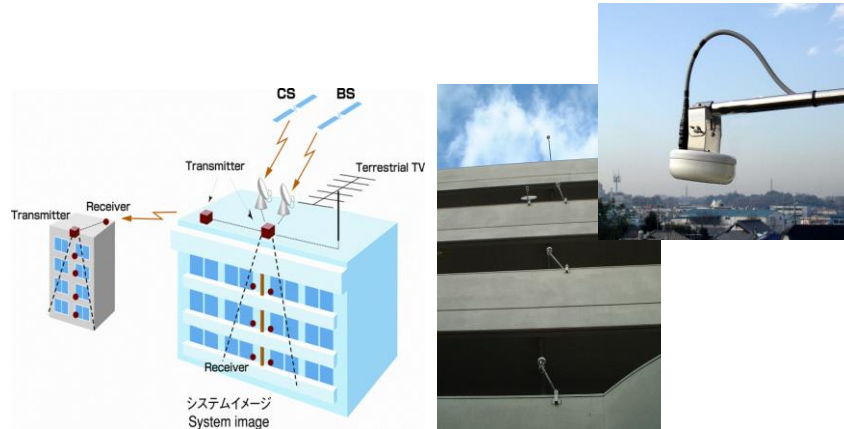
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# Background & Purpose

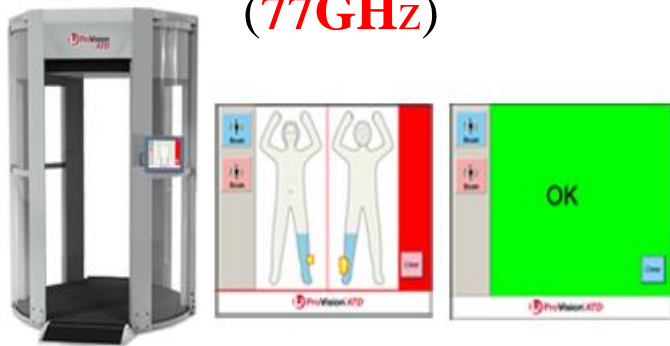
The millimeter-waves have been widely used recently in our daily life.



automobile collision  
avoidance radar system  
(77GHz)



Bulk image transfer system for outdoor  
(60 GHz) [IEEE 802.15-04/118]



airport active scanner system  
(24-30 GHz)



Bulk image transfer system for indoor  
(60 GHz)

# **Background & Purpose**

- Few papers have studied the thermal sensation to the exposure of millimeter-wave EMF, and the safety parameters (level, averaged area, and so on) differ significantly among the guidelines.**
- The aim of this study is to investigate how the age or gender affects the thermal sensation threshold of millimeter waves in Japanese.**

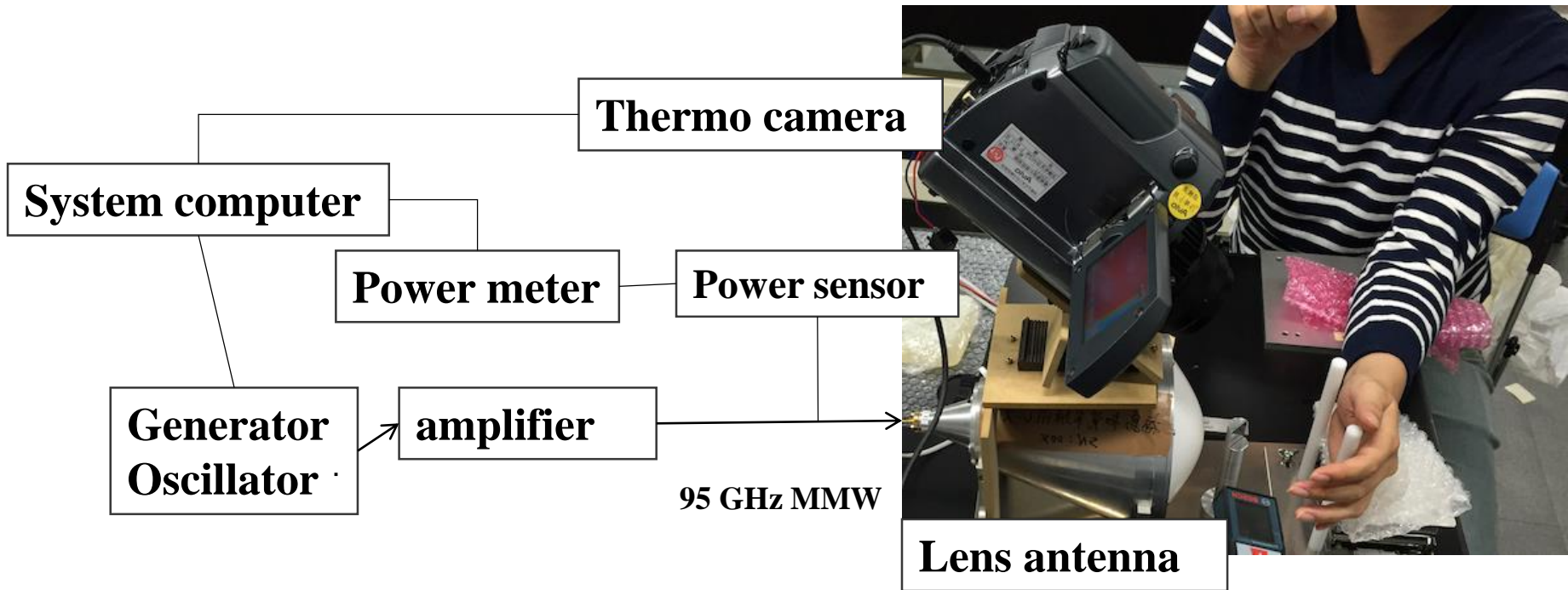
# **Our studies**

- Thermal sensation measurements in Japanese people**
- Does millimeter waves affects peripheral nerves directly?  
Subcutaneous distance of peripheral nerves measurement.**

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# Millimeter wave exposure system

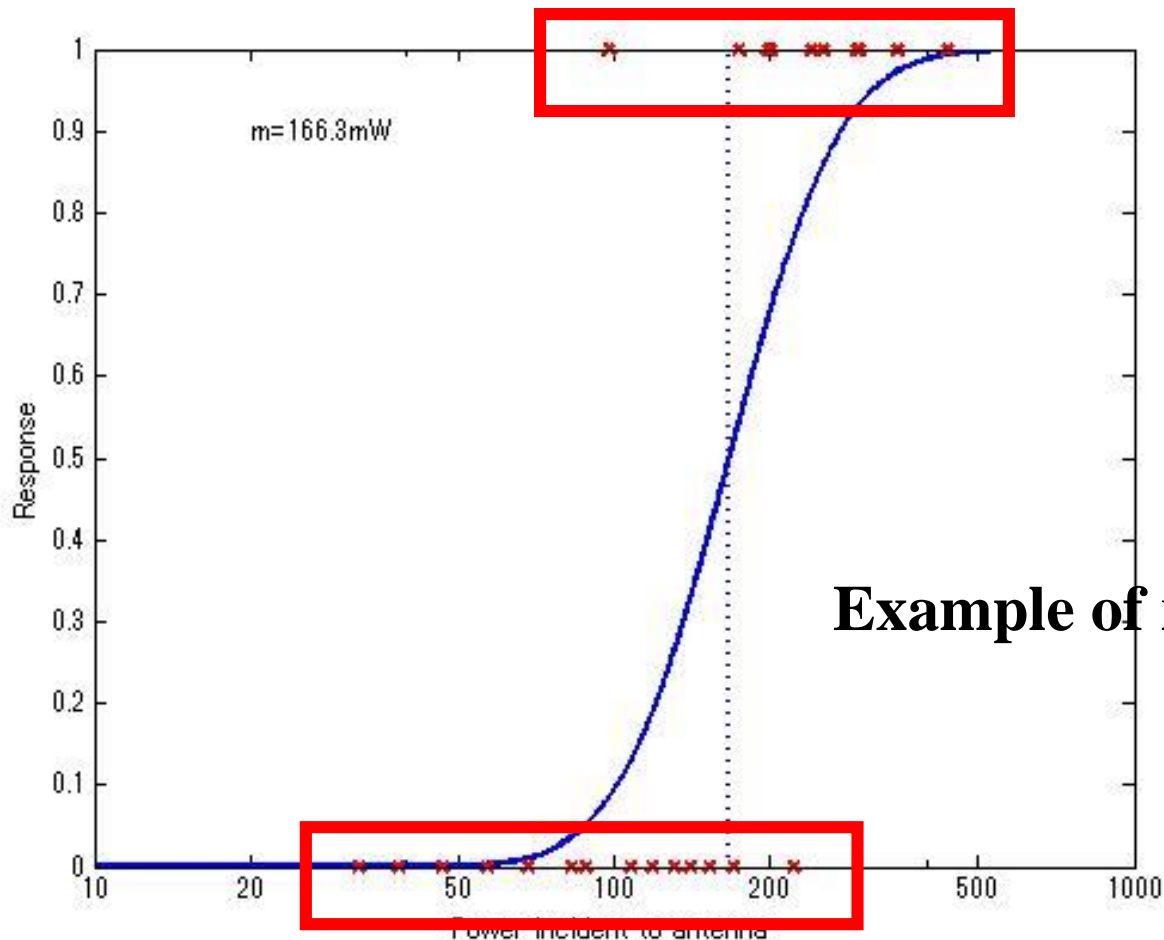


## For safety

- **Hand temperature is continuously monitored**
- **The exposure power is continuously monitored**
- **When intolerable, the subject stop the stimulation**

## • Method of constant stimuli (MoCS) used for threshold measurement

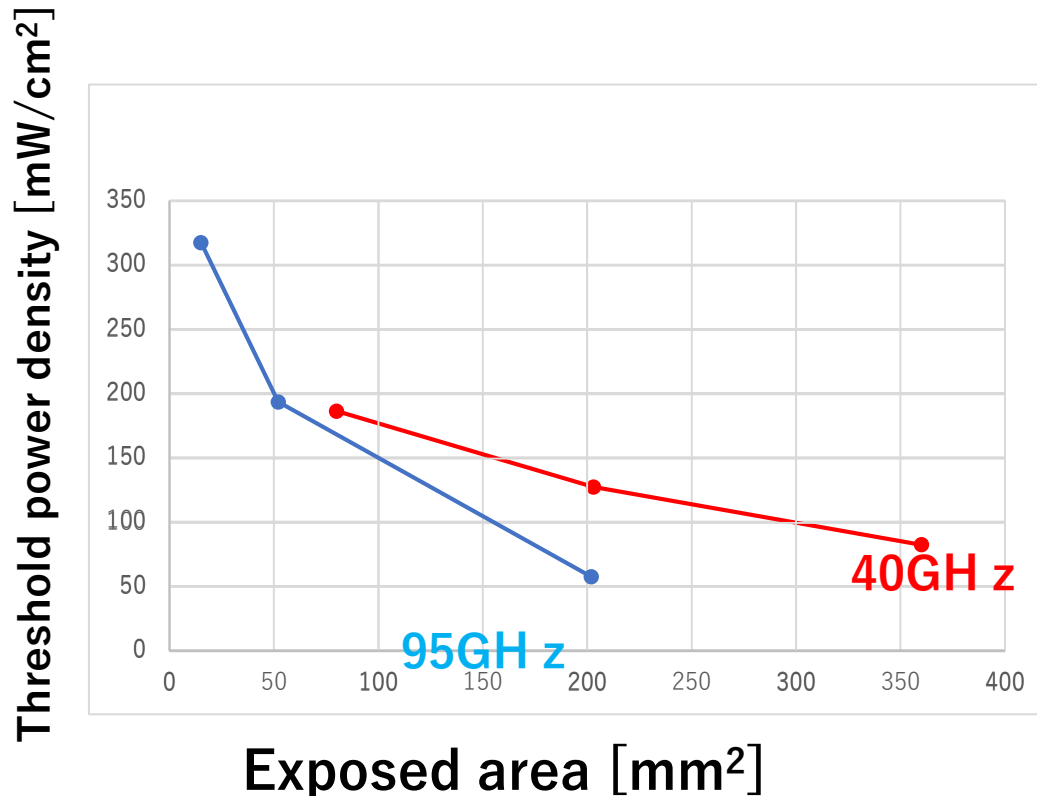
- Stimulus (exposure of millimeter wave EMF) is presented to a subject more than 20 times.
- He/she answers whether he/she feels or not at each trial.
- The incident power density at which the sensation probability is expected to be 50 % is determined as the threshold for each subject by maximum likelihood method.



Example of results (MoCS)

# PRELIMINARY EXPERIMENTS IN 2015, 2016

- The longer exposure time makes the threshold smaller
- The larger exposure area makes the threshold smaller
- These characteristics are seen all frequency waves studied (95, 40 GHz).
- Too long experiments often provoke false positive values because of tiredness.





## **PRELIMINARY EXPERIMENTS IN 2016**

- **Based on the above results in these two years, we plan to make normative values for thermal thresholds when 40GHz MMWs are exposed at 200mm<sup>2</sup> area for at maximum 60 seconds.**

# MAIN EXPERIMENTS IN 2017

One fixed intensity was used (40GHz, 200mm<sup>2</sup>)



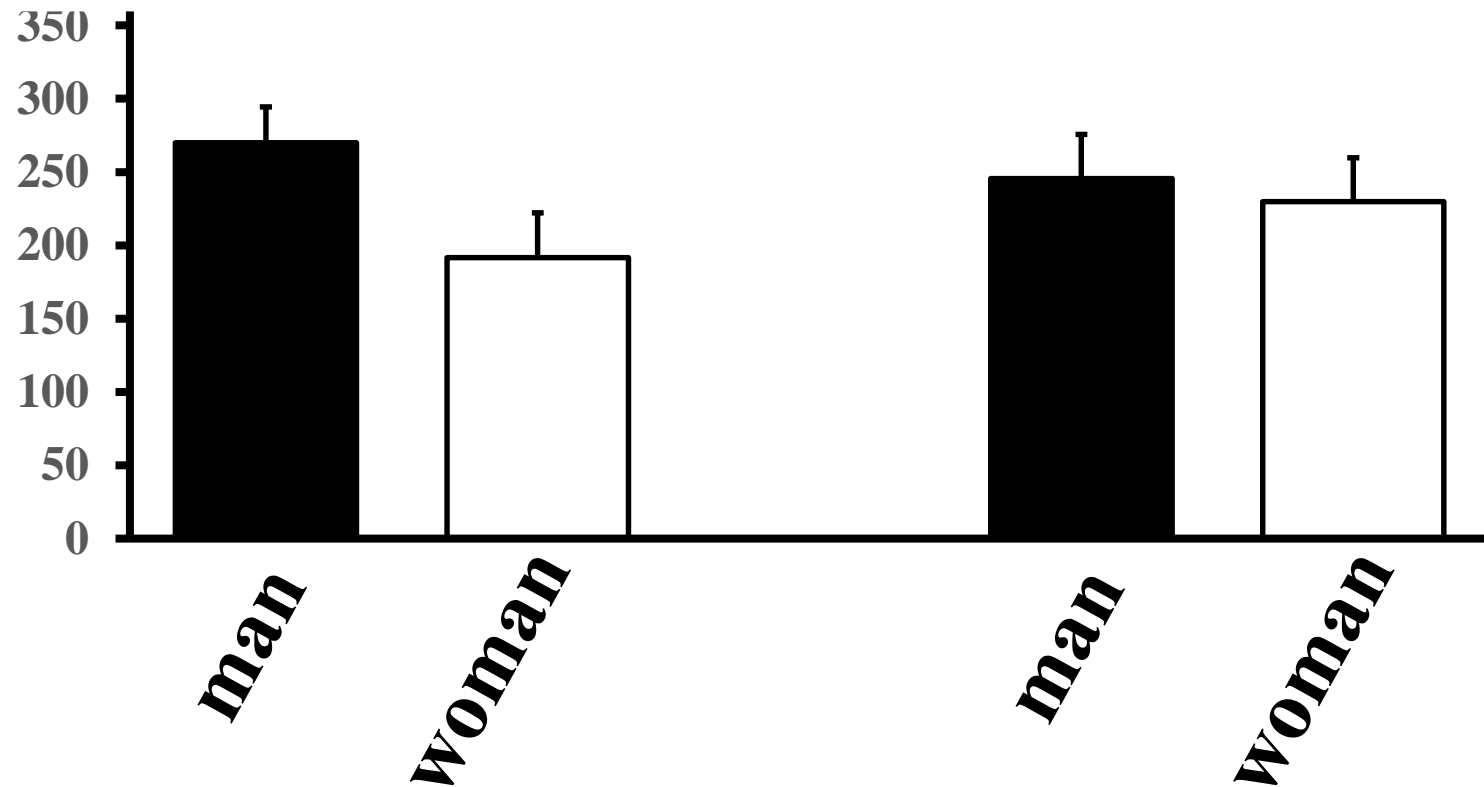
Rest  
30 min



# Results (unpublished data)

< 45-year old

≥ 45-year old



**ANOVA showed no significant effects of age or sex.**

# **Our studies**

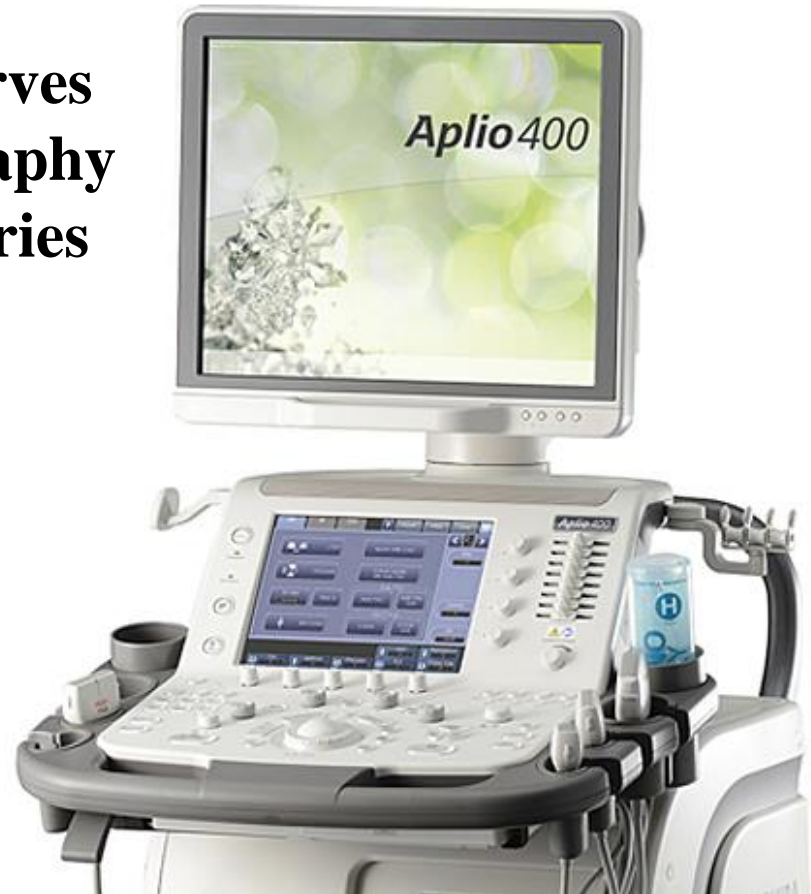
- **Thermal sensation measurements in Japanese people**
- **Does millimeter waves affects peripheral nerves directly?**  
**Subcutaneous distance of peripheral nerves measurement.**

# Depth of the nerves

## Methods

Distances from skin surface to the nerves of median and ulnar nerves were measured with a ultrasonography  
Ultrasound: Aplio 400 Platinum Series  
(Canon, JPN)

Probe: 12 MHz (linear type)



# Depth of the nerves

	Median (wrist)	Ulnar (elbow) bending position	Ulnar (elbow) extension position
Man (N=9)	1.81 ± 0.43 mm	3.49 ± 1.29 mm	5.24 ± 2.07 mm
Woman (N=9)	1.67 ± 0.53 mm	3.07 ± 1.20 mm	4.22 ± 2.13 mm

## Simulation:

40GHz millimeter waves decrease to 1/e at 0.65mm  
1/200 at 1.7mm

ITALIAN NATIONAL RESEARCH COUNCIL (<http://niremf.ifac.cnr.it/tissprop/>)

**The millimeter waves negligibly affects the peripheral nerves directly.**

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