Name	Job Title	Area of Expertise
TANAKA Toshiyuki	Professor	Electromagnetic Wave Application Engineering

1. Main Research Topics

We are developing non-destructive and non-invasive testing devices that use electromagnetic waves and are also conducting research into electromagnetic compatibility (EMC) countermeasures.

① **Development of radar for detecting horizontal cracks on highways and bridges**

It is known that horizontal cracks occur inside the concrete of highways and bridges due to the frequent passage of heavy vehicles. Concrete is paved with asphalt, and horizontal cracks in the concrete cannot be seen with the naked eye, so regular inspections are important. In regular inspections, the asphalt is generally removed, and the concrete is destroyed to check for horizontal cracks. However, this method is time-consuming and expensive. Therefore, we are developing a radar device that can detect horizontal cracks non-destructively from above the asphalt.

② **Estimating rebar diameter using commercial radar.**

Using a concrete radar, it is easy to check whether the rebar is present or not. However, to investigate the durability of a concrete structure, the exact size of the rebar (rebar diameter) and its position (cover depth) are required. These accurate values cannot be obtained by normal use of radar. Therefore, our laboratory is developing an algorithm to non-destructively and simultaneously estimate the diameter of rebar in concrete, the cover depth of rebar, and the electrical constants of concrete.

③ **Development of blood vessel detection radar to assist laparoscopic surgery**

In laparoscopic surgery, the time it takes to drill a hole in the fat and deliver the medical equipment to the affected area cannot be ignored. This is because blood vessels are present in fat, and it is necessary to enter the area without damaging the blood vessels. For this reason, an antenna is placed on the laparoscopic forceps and emits electromagnetic waves from the antenna. The emitted electromagnetic waves are reflected by blood vessels, and by analyzing the received electromagnetic waves, it is possible to determine whether or not there are blood vessels nearby. This is expected to significantly reduce the time required for laparoscopic surgery.

④ **Distinguishing between natural and artificial teeth**

We are developing a device that can distinguish between natural teeth and dentures made of ceramics, zirconia, etc. This system uses a dielectric probe to instantly measure the electrical constants of an object and distinguish between natural and artificial teeth in real time. An important theme is the creation of a dielectric probe that can be used for teeth of various shapes.

⑤ **Monitoring the salinity of seawater**

We are developing a system that can observe the salinity of seawater in real time. Even if the seawater is deep at aquaculture sites, we can check the salinity without having to pump the seawater up. We also aim to simultaneously check the degree of pollution of seawater.

⑥ **Electromagnetic compatibility (EMC) measures**

Whenever electric current flows, unwanted electromagnetic waves are generated. Unwanted emitted electromagnetic waves can sometimes cause other electronic devices to malfunction. Therefore, we are developing a simple device for detecting leaked electromagnetic waves and a power supply circuit that does not emit unwanted electromagnetic waves.

2. Keywords

Electromagnetic wave applications, non-destructive testing, non-invasive diagnosis, electromagnetic compatibility (EMC)

3. Remarks and Websites

We aim to develop non-destructive testing equipment and non-invasive diagnostic equipment that utilize electromagnetic waves that do not currently exist. We will also conduct feasibility testing to see if this is possible in principle. We welcome inquiries about testing and diagnosis.

researchmap: https://researchmap.jp/read102593
Laboratory: https://www.eee.nagasaki-u.ac.jp/labs/emlab/study/staff/tanaka/