Cyberscience Center
User Research Introduction

Scattering and Radiation Performance of Ninja Array Antennas

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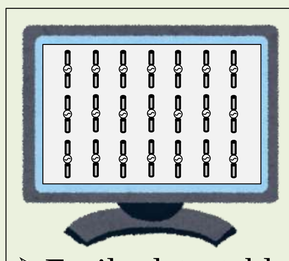
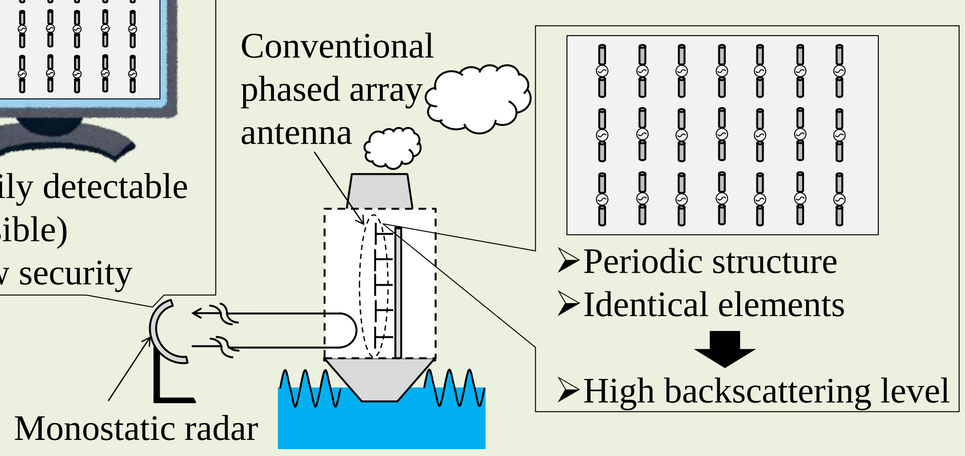
Background/Motivation

Conventional Phased Array Antenna



➢Easily detectable (Visible)
➢Low security

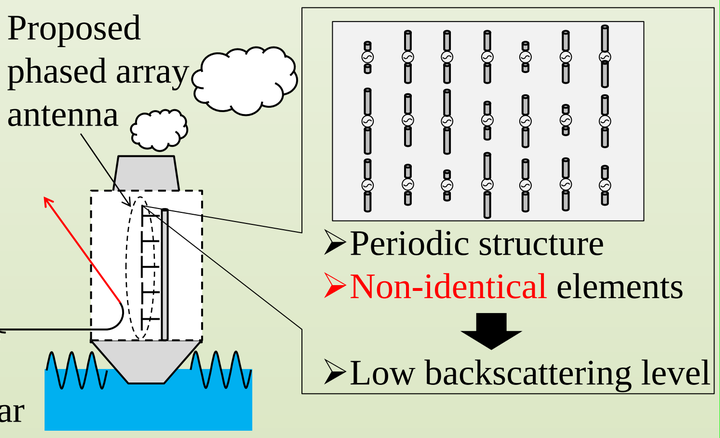


➢Periodic structure
➢Identical elements
➢High backscattering level

Novel low backscattering phased array antenna is required.

Ninja Array Antenna

➢Undetectable (Invisible)
➢High security



➢Periodic structure
➢Non-identical elements
➢Low backscattering level

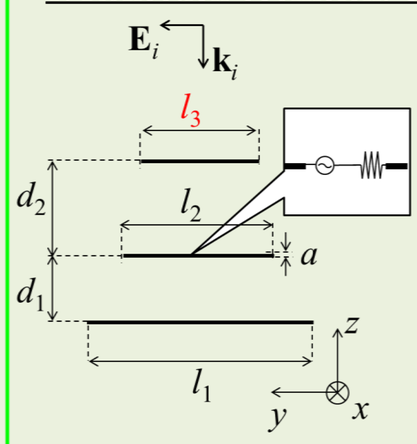
➢Undetectable and invisible like Japanese traditional undercover, Ninja.
➢Problems: How to design the antenna.
How to realize beam scanning performance.

Approach / Method

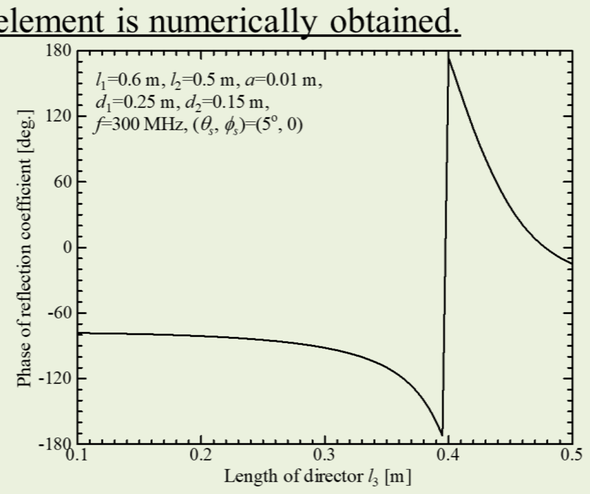
Design of Ninja Array Antenna

➢Design method is in analogous to a method for reflectarray.

1. Reflection coefficient of element is numerically obtained.



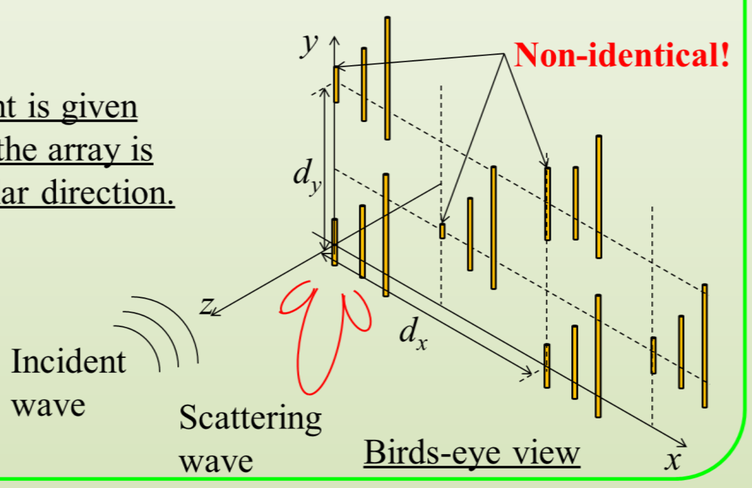
Yagi-Uda element (l_3 is variable)



Phase of reflection coefficient

2. Size of each element is given so that main beam of the array is directed to non-specular direction.

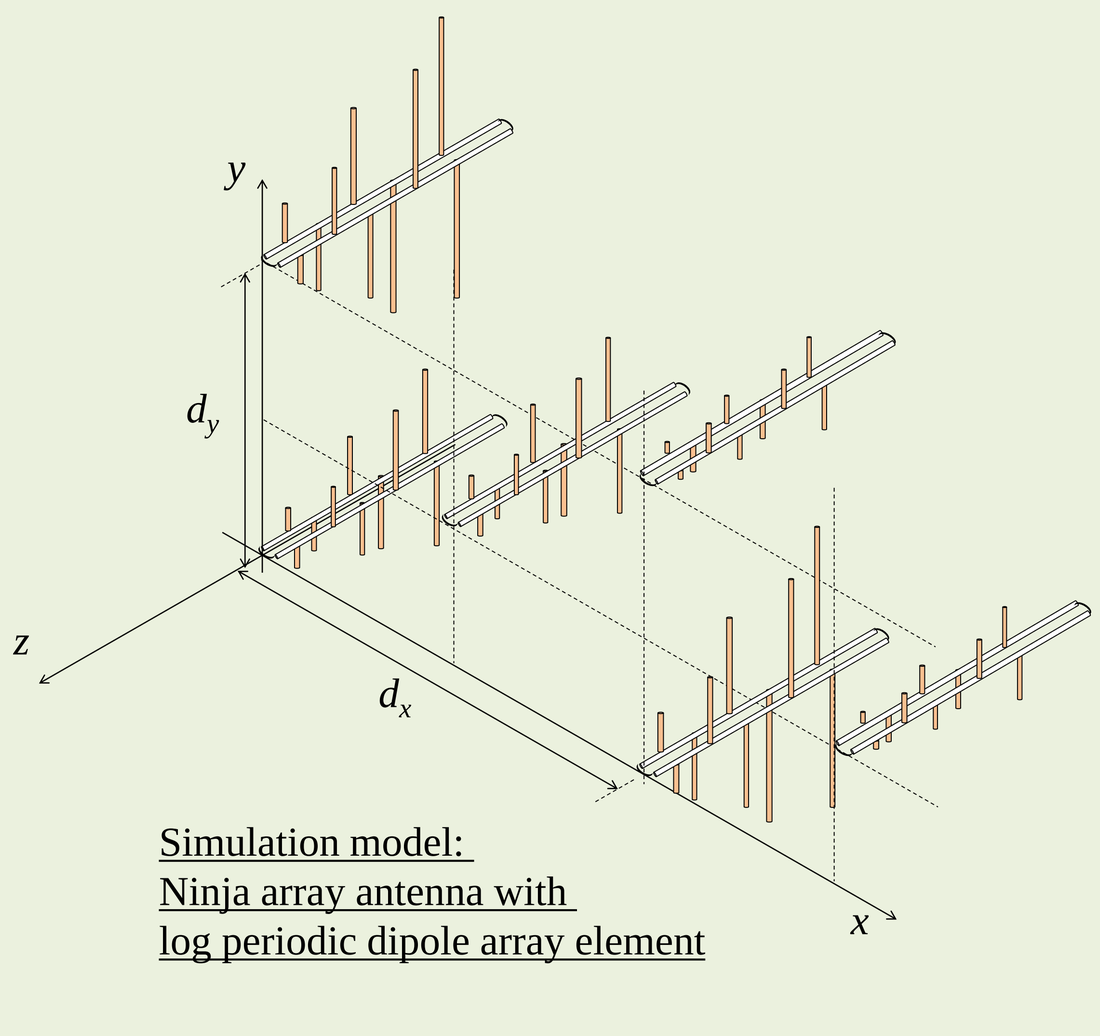
Undetectable!



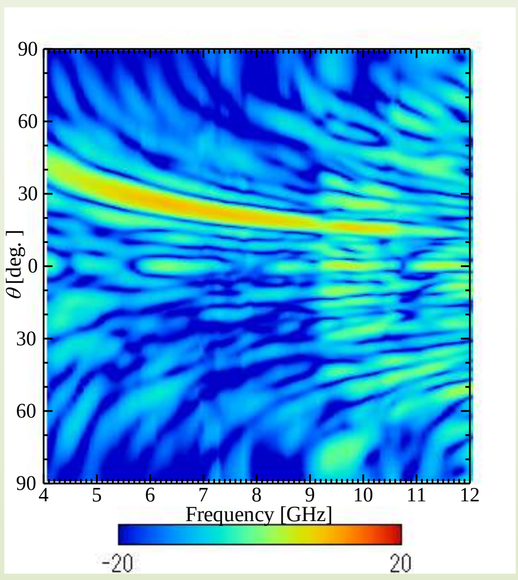
Birds-eye view

Results

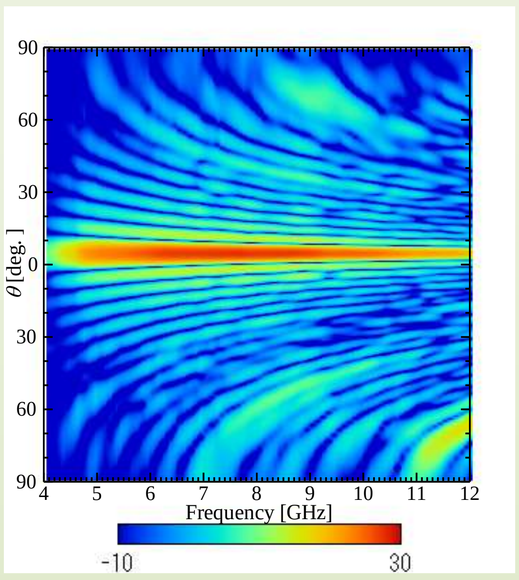
Scattering and Radiation Performance



Simulation model:
Ninja array antenna with log periodic dipole array element



Scattering performance of Ninja array



Radiation performance of Ninja array

➢Numerical simulation was performed using SX-ACE and ***CPU time was reduced from several hours to a few minutes***.
➢Direction of scattering field is non-specular.
→Undetectable by monostatic radar!
➢Direction of radiation field can be controlled to a specific direction (θ=5 deg.).
→Undetectable performance is available without losing performance as a phased array antenna.

Future goals / Expected results

➢Huge-scale Ninja array antenna.
➢Optical Ninja array antenna.
➢Conformal Ninja array antenna.

High security, High frequency, Practical

Expected large computational complexity can be reduced using supercomputing resources!

Supercomputer SX-ACE