

Tu1C

An Efficient Algorithm to Determine the Operational Range of Near-Field On-Body UHF RFID Systems

A. Felaco, K. Yavuz Kapusuz, H. Rogier, D. Vande Ginste Department of Information Technology, IDLab, Ghent University/IMEC, Belgium









IEEE

Near-Field RFID







Operative Range

3

TAG Activation threshold reached Answer through modulation

READER
 ✓ Placed in tag's near-field
 ✓ Sends interrogating signal

• RANGE

✓ Locations where tag is detected
 ✓ Defines system's functionality





Platform Effects

• DETUNING

- ✓ Caused by body proximity
- ✓ Reduces backscattered power
- ABSORPTION
 Some power absorbed by body
 Less power available to tag

• SHADOWING

✓ Objects in between project "shadows"
✓ Tag becomes "hidden"

_			
┍╌┸╼	-	<u> </u>	
		T I	
		ĴΤ	



Tu1C-2



Friis Formula → "Cheap"

5

TAG

- ✓ Located in reader's near-field
- ✓ Should receive enough power
- DIRECTIVE READER
 ✓ Assumes far-field operation
 ✓ Operates at max allowed power

• INACCURATE RANGE

✓ Ignores platform effects✓ Very quick to determine







Full-wave Software → "Expensive"

Connecting Minds. Exchanging Ideas.

NIMS

✓ Rigorously analyzed









This Work

• FAR-FIELD as INPUT

✓ Under deployment conditions

✓ Accounts for platform effects

FAR-to-NEAR TRANSFORM
 ✓ Employs multipoles expansion
 ✓ Produces precise near-fields

ACCURATE COMPUTATION
 ✓ Evaluates near-fields interaction
 ✓ Runs in just a few seconds







EFIE & Reciprocity Theorem











Multipoles Expansion



9





Measurements

10

• TEXTILE TAG

- ✓ Strapped on the arm
- \checkmark Loaded by 50 Ω impedance

STANDARD GAIN HORN ✓ 866 MHz

✓ Near-field within 6λ

• MEASUREMENTS

✓ Power received by tag
✓ Power backscattered to reader







Measurements









Measurements









Simulations

13

• TEXTILE TAG

- ✓ Multi-layer arm phantom
- \checkmark Realistic ε_r and σ values
- STANDARD GAIN HORN
 ✓ 866 MHz
- ✓ Near field within 6λ

• SIMULATIONS

- \checkmark Power received by tag
- ✓ Comparison with full-wave and Friis formula





227

Simulations



14





Performance











Operative Range



16







Conclusions & Future Work

- Novel method outperforms traditional tools.
 - Only requires accurate far-field data under deployment conditions.
- It efficiently precomputes crucial data.
- Efficiently and accurately predicts operative range.
- Validated by simulations and measurements.
- Future plans involve
 - extend the advocated method to multiport devices,
 - test different RFID tag platforms,
 - include reflectors.



