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Distance Measurement of RFID-Tags

An algorithm has been developed to determine the distance between an RFID-reader and a tag involved in the communication. Although based on wideband TOF (time of flight) algorithm, this algorithm can be applied for existing tags without the need for modification. The algorithm can be used for passive, semi-passive, and active tags which use backscattering-communication. In combination with AOA (angle of arrival) algorithms and/or multiple RFID-readers tags can be localized.

BACKGROUND

Distance information is essential for many applications in RFID. While this can be solved in many ways for dedicated ranging enabled tags (battery powered, expensive, non-standard), no satisfying solution exists for regular tags. The signal level received by the reader only gives inaccurate information about the distance reader to tag. Classical TOF-methods cannot be applied due to regulatory requirements and/or the fact that these algorithms are not able to distinguish between static reflections and the one from the tag. Other algorithms like triangulation require a calibrated setup of multiple readers which is difficult to deploy.
The patented algorithm allows tag-ranging (and localization when combined with AOA) for any backscattering-tags without the need for modifications of the tag. The algorithm only needs a single reader but can utilize multiple readers for increased accuracy as well.

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A broadband modulated signal is superimposed onto the reader-tag communication still fulfilling regulatory requirements for RFID-readers. The algorithm utilizes the fact, that the backscattering-modulation of the tag also influences the phase of the reflected broadband signal. It is possible to suppress static echoes and emphasize the reflection of the tag involved in the communication only. While existing algorithms would detect room echoes as well (straight forward correlation), the patented method's correlation maximum clearly indicates the distance of the tag (Fig.1).

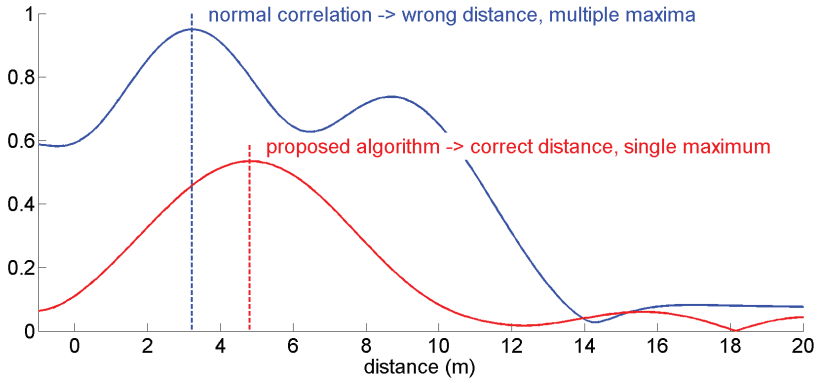

Fig.1: Correlation maximum of ranging algorithm.

REFERENCE:
M021/2011

DEVELOPMENT STATUS:
An FPGA-implementation of a ranging enabled RFID reader is available. The unit connects to a laptop and demonstrates real-time localization of multiple RFID tags.

KEYWORDS:
RFID, distance measurement, ranging, localization, existing tags

IPR:
Patent granted in AT
EP and US applications filed

COOPERATION OPTIONS:
- License agreement
- Development partnership

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For improving the algorithm and ongoing research, an FPGA-implementation of a ranging enabled RFID-reader was made and tests were performed. Figure 2 shows a statistical analysis of the distance estimate for four tags. Although the results are not perfect, they show a maximum error of <25cm which outperforms all other localization approaches.

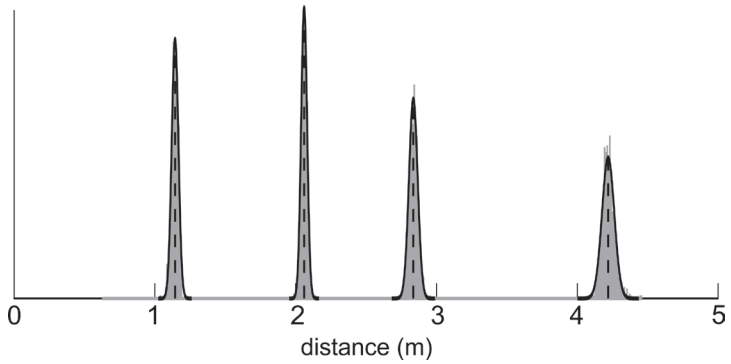

Fig.2: Ranging results with four RFID tags. The tags were exactly positioned at 1m, 2m, 3m, and 4m.

BENEFITS

- Almost any RFID-tags/labels can be used (e.g. regular EPCRFID tags)
- Works with passive, semi-passive, and active tags
- Ranging algorithm does not influence tag-to-reader communication
- Localization of tags with a single reader

APPLICATIONS

- Any RFID-tag ranging and/or localization application
- Security applications which require defined communication distances

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