



icsDOA

ADVANCED DOA ESTIMATION

iterative **c**ompressive **s**ensing **d**irection **o**f **a**rrival estimation (icsDOA) is the most advanced technology to determine the location of origin for radio, radar or sonar. Fast and accurate - our optimal antenna array and signal processing solution cannot be beat. Literally.

UNPARALLELED ACCURACY

Targeting like no one else can; with a sufficient SNR ratio, there is essentially no limit to the accuracy that is achievable.

FASTER THAN FAST

Low computational complexity, lower processor requirements, and lower battery drain results in increased operational performance in portable units.

UNBEATABLE

With a solution that achieves the Cramer-Rao Lower Bound on estimation error, no other approach can do better.



Direction of arrival (DOA) estimation is used to determine the location of a radio source. It is an 80 year old problem, and still crucially important in defence. However, current methods are computationally complex, and many applications demand improved speed, accuracy and precision.

icsDOA

NOBODY CAN COMPARE

AN ELEGANT SOLUTION

icsDOA comprises both a new signal processing solution and the optimal antenna array geometry. Unlike other techniques which all require multiple time samples of the antenna array output, our solution works on optimised post-processing from just a single time sample.

UNPARALLELED ACCURACY

Our angle of arrival estimation technique provides error performance on the Cramer-Rao bound for any signal to noise (SNR) ratio. Therefore, with a sufficient SNR ratio, there is essentially no limit to the accuracy that is achievable.

FASTER THAN FAST

A super optimized signal processing algorithm means that our solution has significantly lower computational complexity than all other approaches. Indeed, our recursive algorithm is so strongly convergent that it achieves superior positioning in just 2 iterations. In other words, it is fast. Really fast. It is processor 'light', and thus has low battery drain giving extended performance in portable units.

LOW NOISE. LOW ERROR.

Because the algorithm does not use signal amplitude, and has a high degree of angular resolution, icsDOA has large immunity to multi-path induced error. Put plainly, we can more effectively discriminate direct paths from reflected paths, enabling us to determine the true point of origin with unmatched speed and accuracy.

WHEN SIZE MATTERS

We have determined the optimised antenna array geometry for maximum performance with minimum error, enabling both ideal configurations, and space constrained installations that push the boundaries of small. Coupled with our algorithm to extract the best from small antenna array geometries, icsDOA enables realistic options for miniaturized portable / mobile in-field units.

AN EASY UPGRADE

Do you already have a significant investment in hardware? Our signal processing method can be used with *any existing antenna array geometry*, to get the best performance possible out of pre-existing setups. Plus, upgrading to icsDOA is fast, which means no operational downtime. Installing new hardware? Our optimised antenna array configurations can be tailored to suit any application.

UNBEATABLE

Our accuracy and computational performance is significantly better than all other approaches, e.g. MUSIC, Root-MUSIC and ESPRIT. In-fact, with a solution that achieves the Cramer-Rao Lower Bound on estimation error, no other approach can do better. Literally.



icsDOA

NOT JUST A GAME CHANGER,
IT IS DOA ESTIMATION ENDGAME

APPLICATIONS

- **Location of radio transmitters, stationary or moving**
- **Identification of friendly or foe**
- **Identification of jammers & spoofers**
- **Applicable to radio, radar and sonar**
- **Mobile direction of arrival units for in-field deployment**
- **Signal-processing method is a standalone solution that can retro-fitted to any existing antenna array geometry**





icsDOA OPPORTUNITIES

icsDOA performance has been simulated across multiple scenarios. Our signal processing solution is ready for adapting to existing antenna arrays, and our optimal antenna array configuration is ready to prototype.

icsDOA is open for partnership and licensing opportunities. Interested? Contact us.

INVENTORS

Assoc. Prof. Sam Reisenfeld
Dr. Audri Biswas

PATENT POSITION

PCT: *Direction of Arrival Estimation*

PUBLICATIONS

Biswas, Audri and Sam Reisenfeld. "New high resolution direction of arrival estimation using Compressive Sensing." *2017 IEEE 22nd International Workshop on Computer Aided Modeling and Design of Communication Links and Networks (CAMAD)* (2017): 1-6.

FIND OUT MORE:

A/Prof Sam Reisenfeld
*School of Engineering
Faculty of Science & Engineering*
T: +61 477 293 726
E: sam.reisenfeld@mq.edu.au

Anna Grocholsky
Director
T: +61 437 463 317
E: anna.grocholsky@mq.edu.au

The Office of Commercialisation
and Innovation

Level 3 (West), Building C5C
Macquarie University
NSW 2109 Australia
T: +61 9850 4576
E: innovation@mq.edu.au

mq.edu.au/innovation
twitter.com/MQInnovation

