Quick-look Processor for ISAR Imaging of Sea Vessels

Background

ISAR images are a rich source of information used for, amongst other things, the classification of objects. Producing such images is dependent on the quality of the data collected, as well as the algorithms used to focus the images.

Quality control of ISAR data collected during fieldwork is needed to ensure the continuation of the research area. Such a system should be low in computation to avoid the need for expensive, specialized computers in the field

Objectives

- Implement 4 low computation motion compensation algorithms.
- Combine the algorithms and select the fastest combination that produces the best focused images of the sea vessel.
- Build a QLP that can be used for data quality assessment in the field.

Method

System Design

- The 2 Range Alignment (RA) and 2 Autofocus (AF) algorithms were implemented in MATLAB. Both simulated and measured data was used to verify and validate the implementations.
- These algorithms were alternately combined to form 4 candidate QLP designs.
- Each design was time tested using measured data frames and all were found similarly efficient. Therefore, the design which produced the best focused images was selected for use in the final QLP.

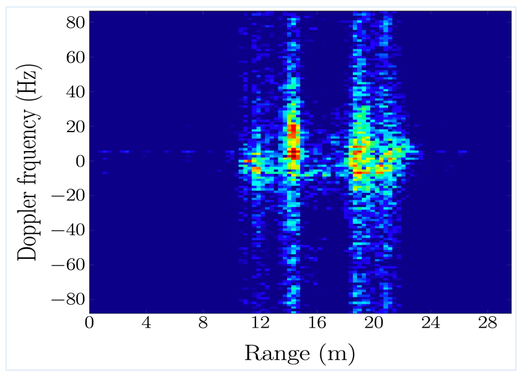


Image produced using Peak RA and Single Dominant Scatterer AF

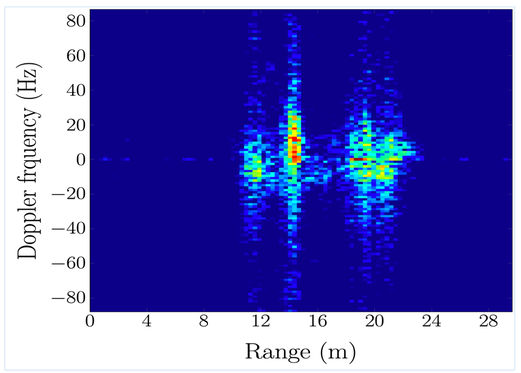


Image produced using Peak RA and Multiple Dominant Scatterer AF

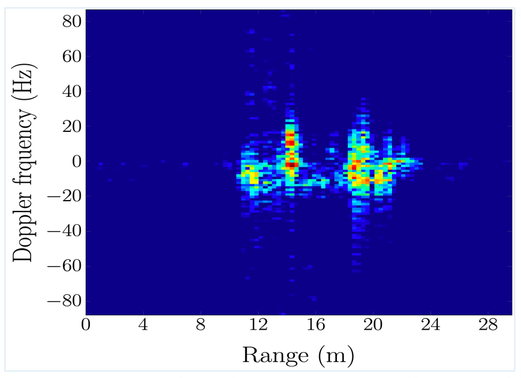


Image produced using Haywood's RA and Single Dominant Scatterer AF

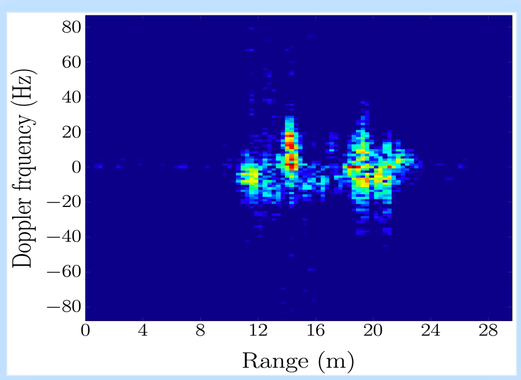
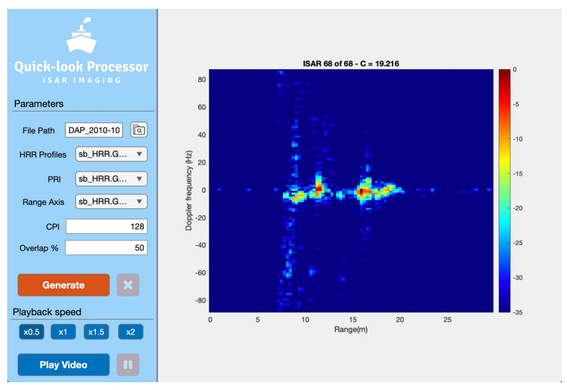


Image produced using Haywood's RA and Multiple Dominant Scatterer AF

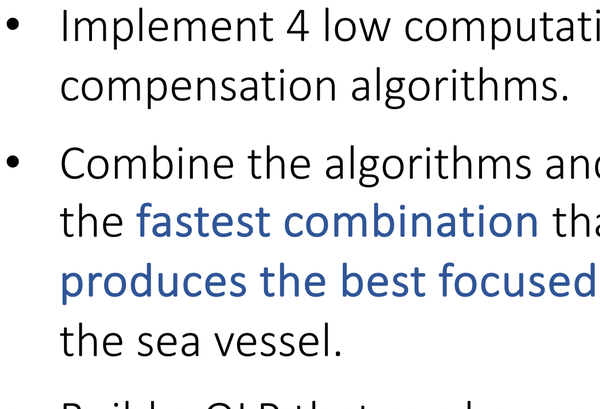
App Design

A MATLAB App was designed to increase usability of the QLP.



Results

Two datasets provided by the CSIR, capturing the same boat using different system configurations, were employed to demonstrate the QLP's applicability in evaluating data quality for ISAR Imaging.



Optical Image of the boat

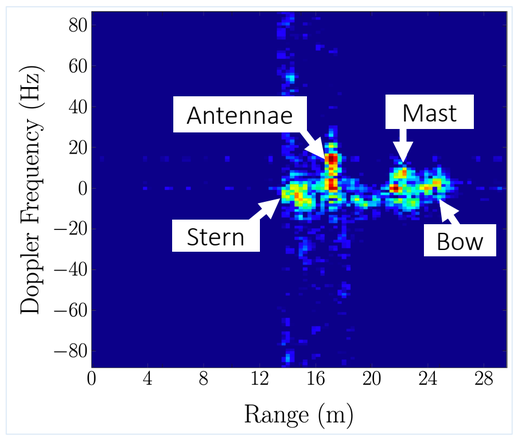


Image produced using Dataset 1

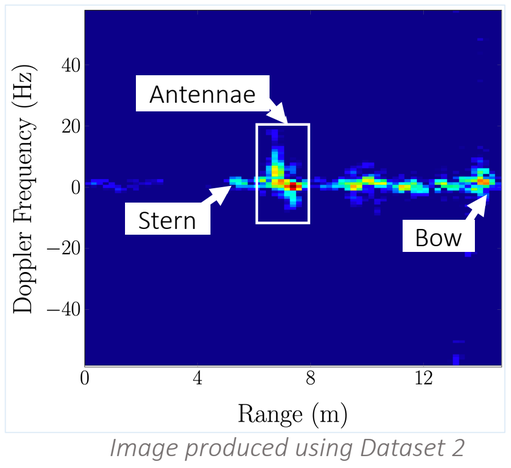


Image produced using Dataset 2

It was found that the QLP successfully produced focused images from both datasets. However, there were differences in the images; dataset 1 produced images that better characterised the boat. Thus, it was found that the resolution (quality) of dataset 2 was not conducive to producing images that correctly characterise the boat.

Conclusion

A QLP which generates focused ISAR images of sea vessels was designed and developed. Additionally, its runtime efficiency and user-friendly design make it a valuable tool for assessing the quality of recorded data during field experiments.

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