Parallelization of a Denoising Algorithm for Tonal Bioacoustic Signals using OpenACC Directives

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Motivation

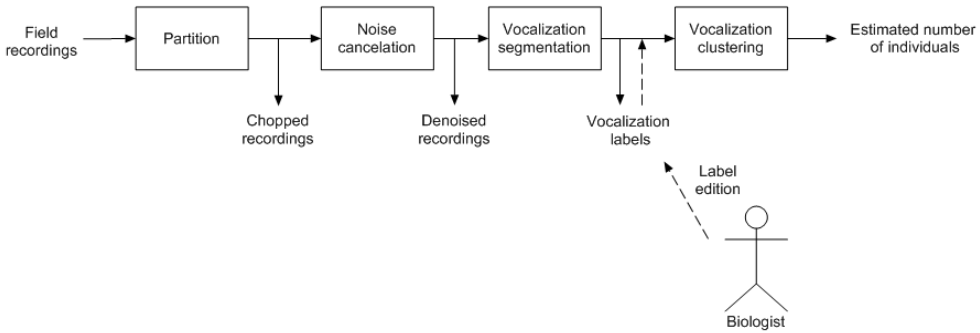
Smithsonian Tropical Research Institute

ECCI Escuela de Ciencias de la Computación e Informática

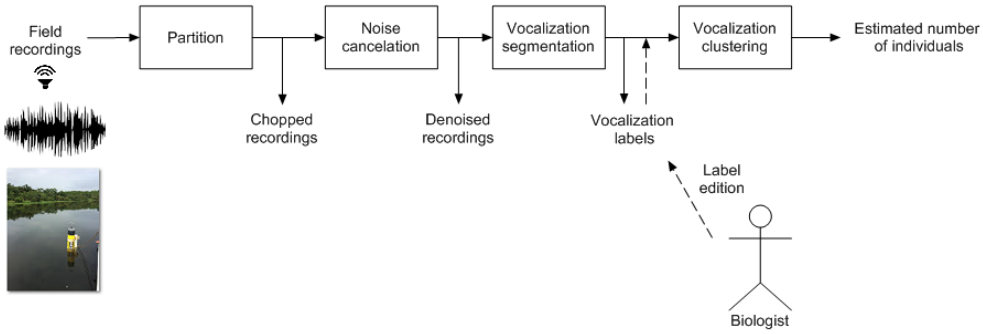
CITIC

CeNAT

Automatic Manatee Count Method



Automatic Manatee Count Method



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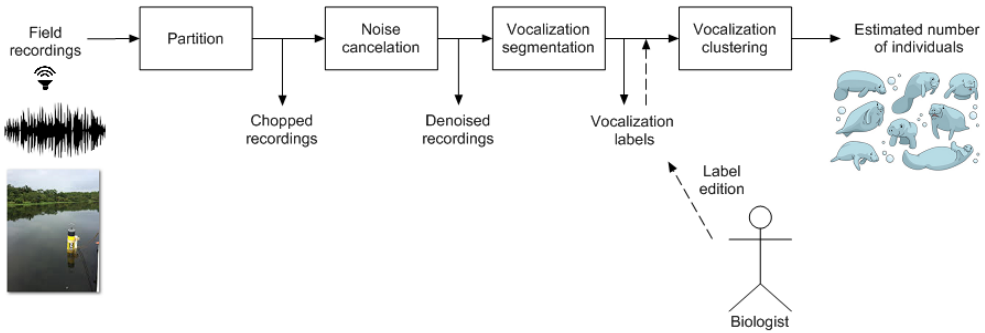

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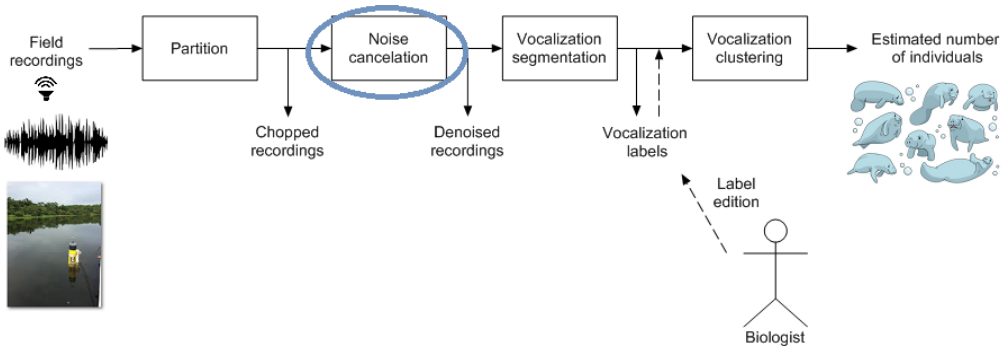

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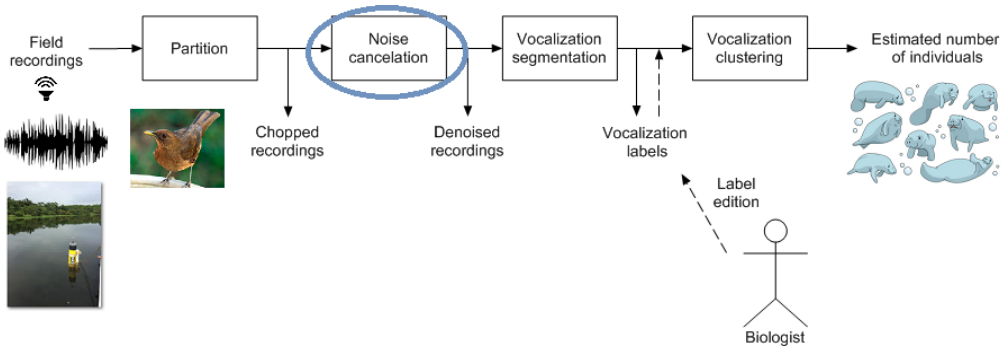

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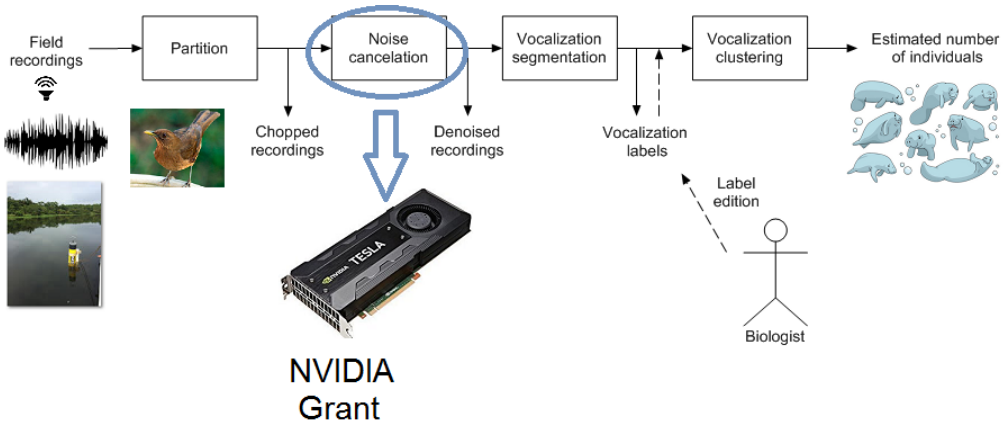
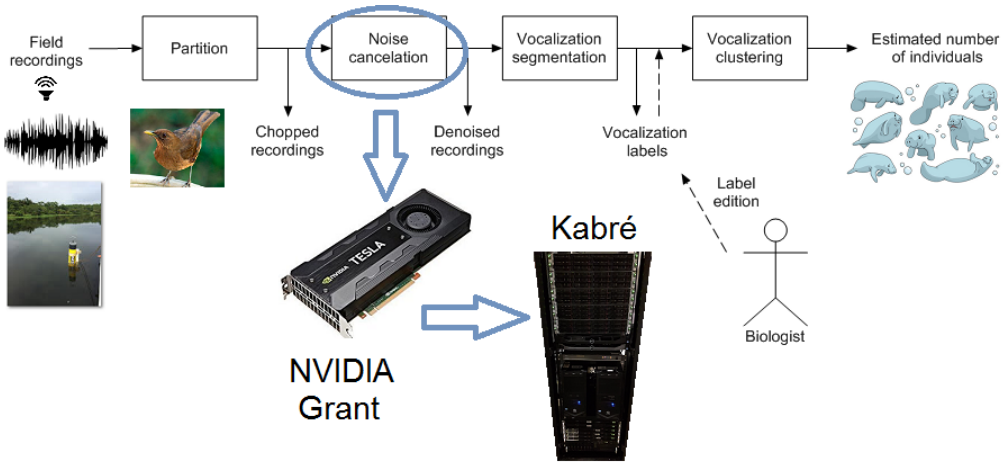
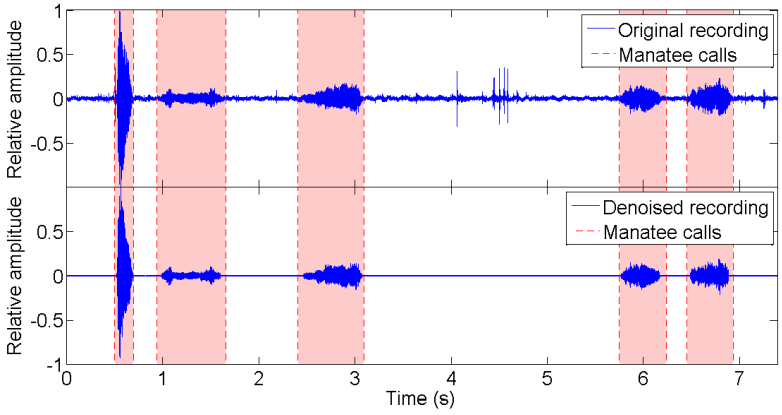


Automatic Manatee Count Method

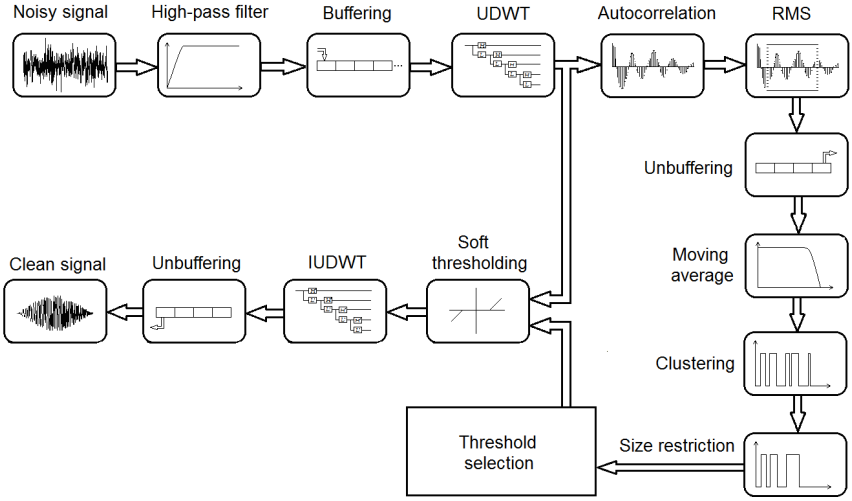


Denoising method

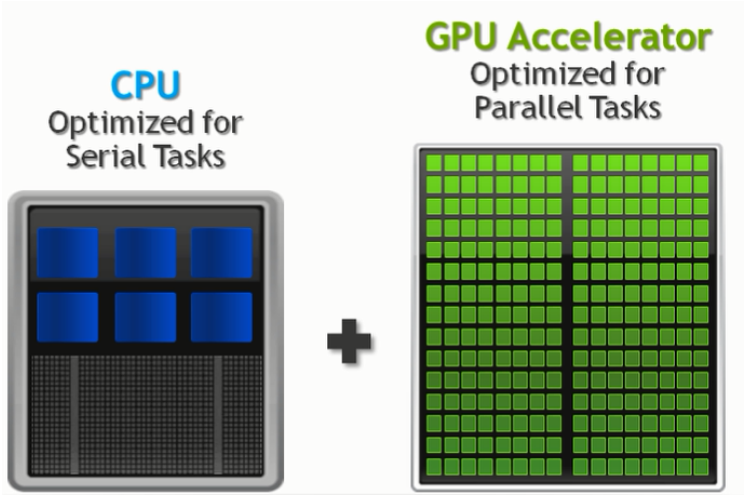


- Original
- Denoised

Denoising method



Why GPUs?


CPU
Optimized for
Serial Tasks
GPU Accelerator
Optimized for
Parallel Tasks

Why OpenACC?

OpenACC

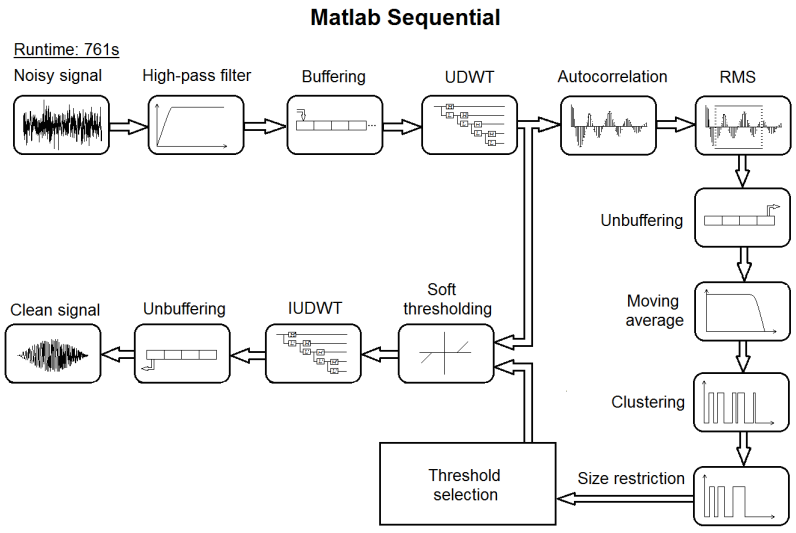
Directives for Accelerators

OpenCL

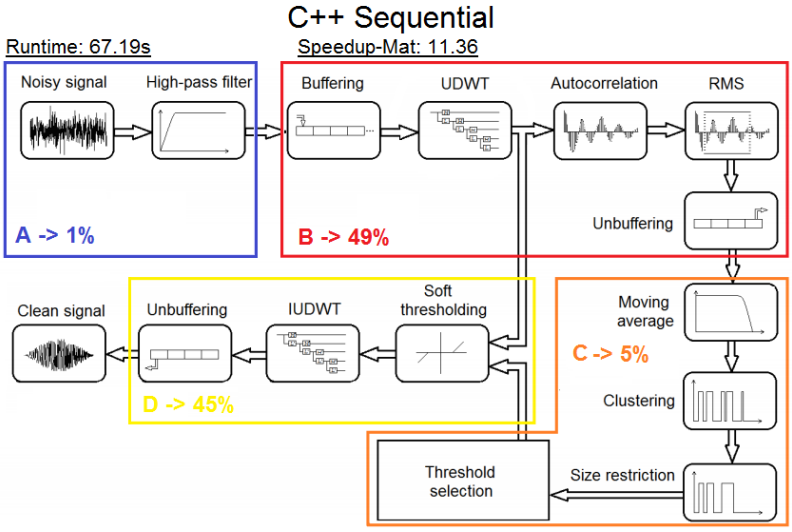
NVIDIA®

CUDA®

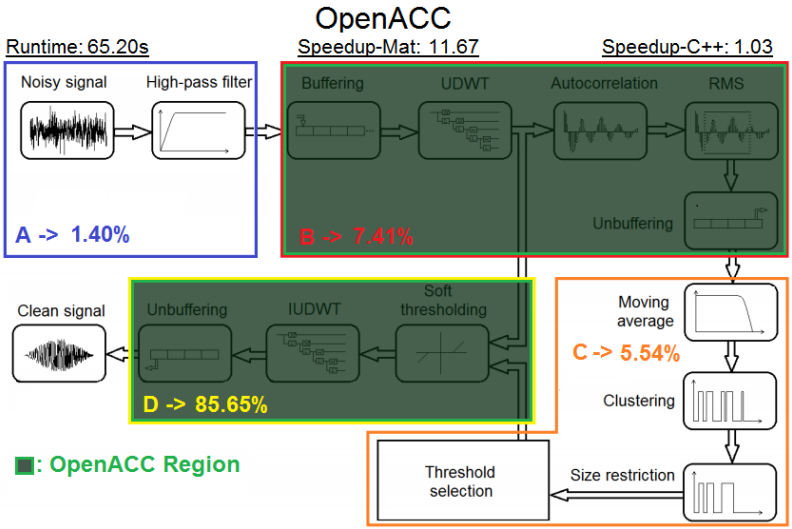
Original implementation



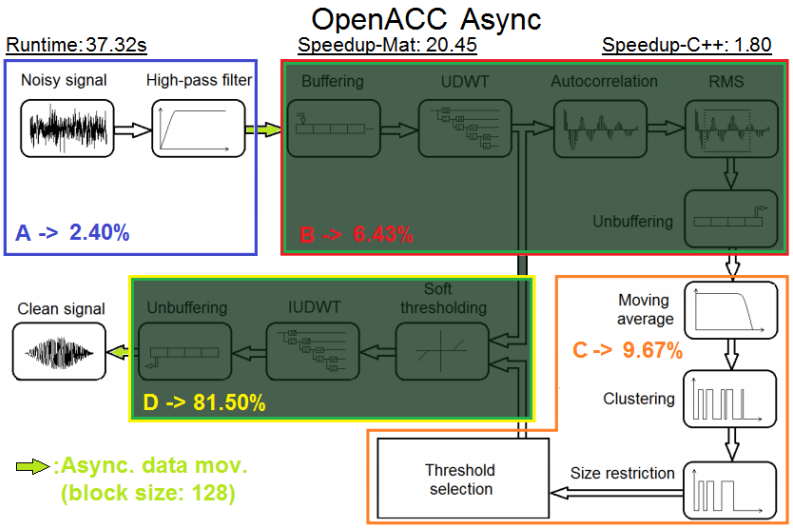
Profiling in C++



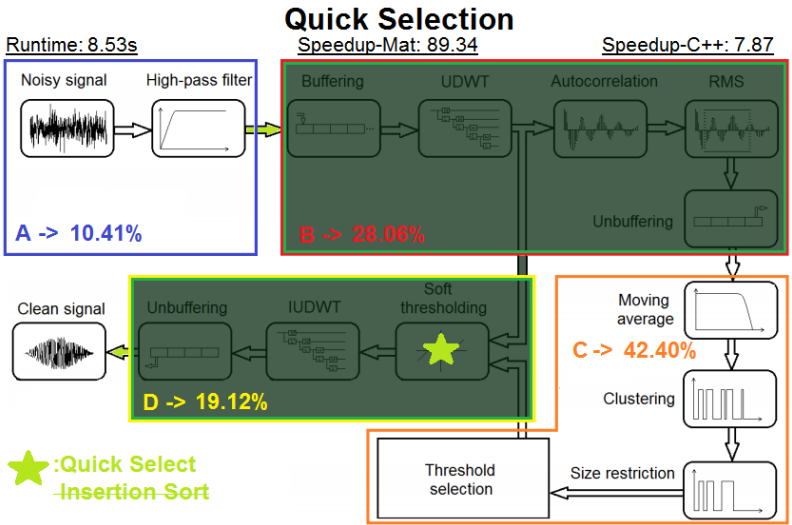
Parallelizing with OpenACC



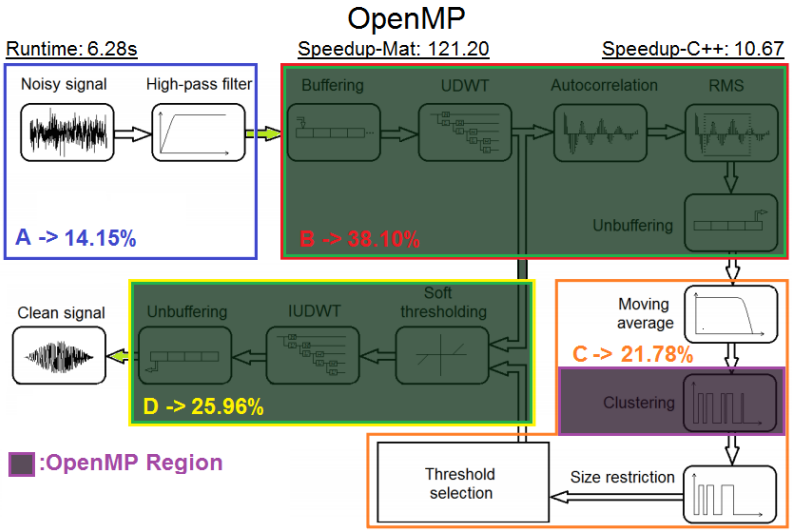
Asynchronous data movement



Quick Select Algorithm



Dynamic clustering parallelization



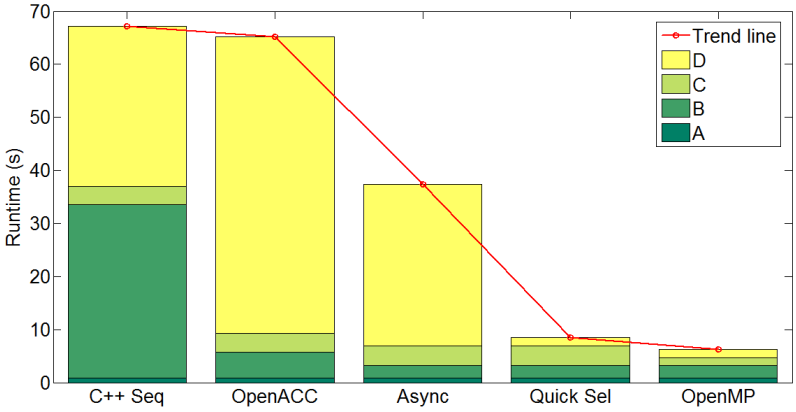
Speed-up

Table: Ten runs using a nine-minute manatee vocalization recording.

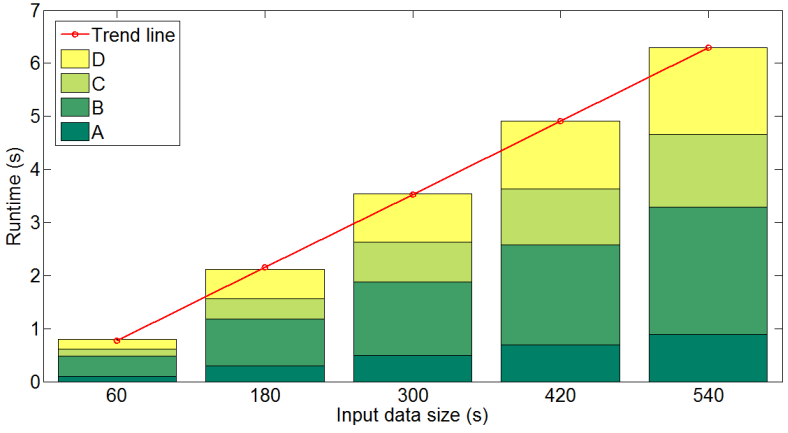
Code	Arch	Duration (s)	Speed-up$_M$	Speed-up$_C$
Matlab	CPU	761.714 ± 1.73	1	0.09
C++ Seq	CPU	67.07 ± 0.11	11.36	1
OpenACC	GPU	65.29 ± 0.07	11.67	1.03
Async	GPU	37.24 ± 0.05	20.45	1.80
Quick Sel	GPU	8.53 ± 0.01	89.34	7.87
OpenMP	GPU	$\mathbf{6.28 \pm 0.01}$	**121.20**	**10.67**
Multicore	CPU	14.51 ± 0.02	52.49	4.62

- CPU: Intel Xeon CPU E3-1225 v5 @ 3.30GHz (quadcore)
- GPU: Tesla k40c

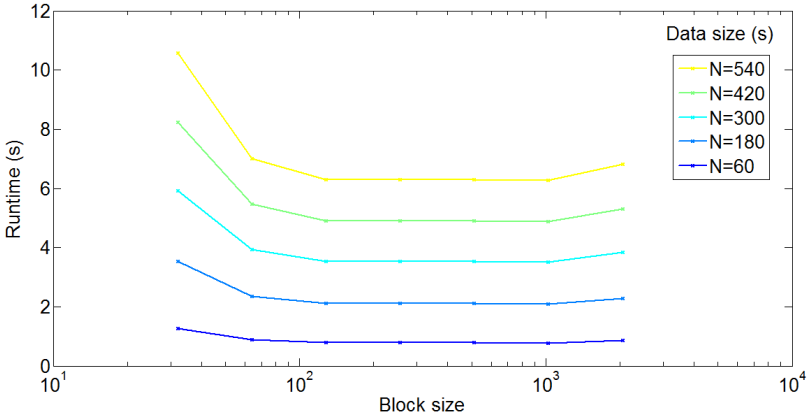
Runtime decomposition



Scalability: input data



Scalability: block size



Speed-up: C++ optimized algorithm

Table: Ten runs using a nine-minute manatee vocalization recording.

Code	Arch	Duration (s)	Speed-up
C++ Seq QS	CPU	46.13 ± 0.11	1
OpenACC QS	GPU	15.32 ± 0.06	3.01
Async QS	GPU	8.53 ± 0.01	5.41
OpenMP QS	GPU	$\mathbf{6.28 \pm 0.01}$	**7.34**
Multicore QS	CPU	14.51 ± 0.02	3.18

- CPU: Intel Xeon CPU E3-1225 v5 @ 3.30GHz (quadcore)
- GPU: Tesla k40c

¡Thank you!

- First parallelization of a bioacoustic algorithm using OpenACC
- The algorithm scales linearly
- Maximum speed-up $S_M = 121.2$ and $S_C = 10.67$

¿Questions?

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