

Evaluation of the Intel Xeon Phi Co-processor to accelerate the sensitivity map calculation for PET imaging

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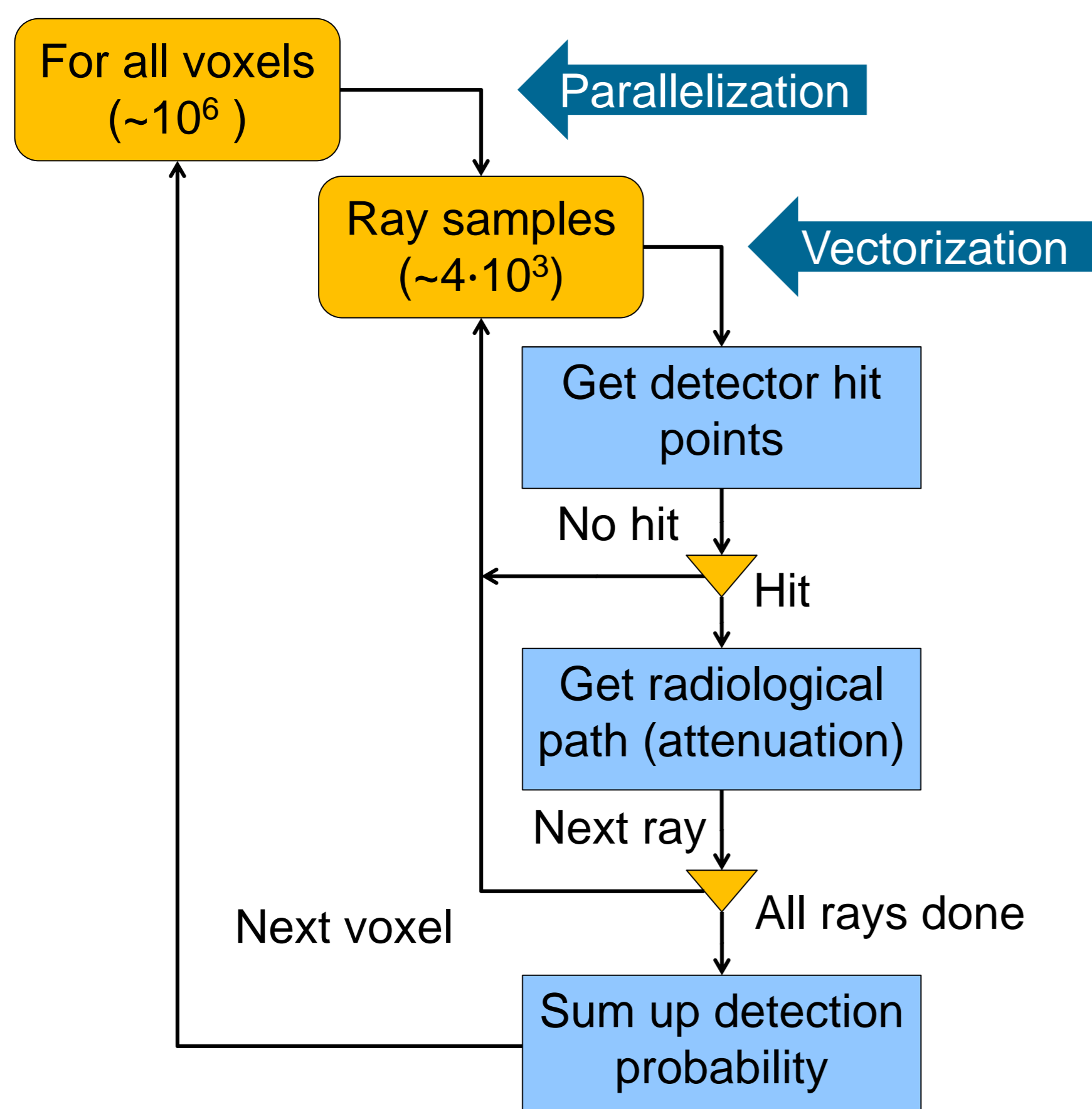
Purpose:

In this study we:

- ... aim at evaluation of the Intel Xeon Phi co-processor for acceleration of 3D positron Emission Tomography (PET) reconstruction
- ... aim at portable implementation running on host and Intel Many Integrated Core (MIC) architecture
- ... focus on sensitivity map generation as one computational hot spot and promising candidate for acceleration by MIC

Material and Methods

Algorithm for sensitivity map determination:



Implementation:

- Embree ray tracing kernels, optimized for Xeon and Xeon Phi
- Single Program Multiple Data (SPMD) compiler (ispc) to exploit vectorization on host and MIC platform
- Offload programming model on MIC

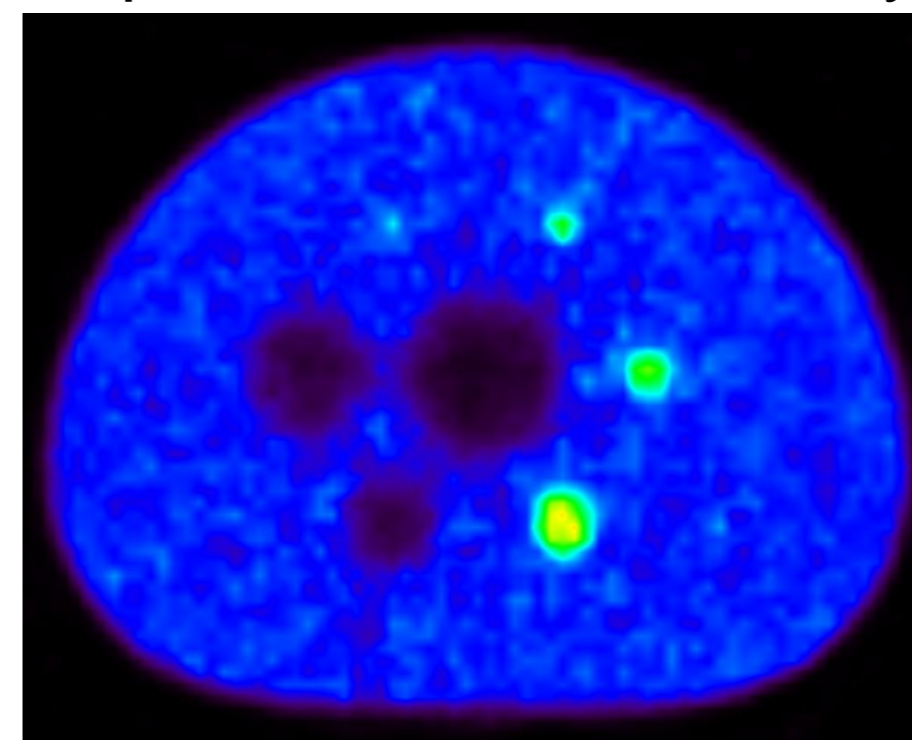
Platform:

- Host system: (HP SL250s Gen8, 64 GB RAM) 2x Xeon(E5-2670) CPUs @ 2.6-3.3 GHz, 16 threads each (Hyper-threading)
- Coprocessors: 2x Xeon Phi (5110P) with 60 cores @ 1GHz, 240 threads and 8GB RAM each

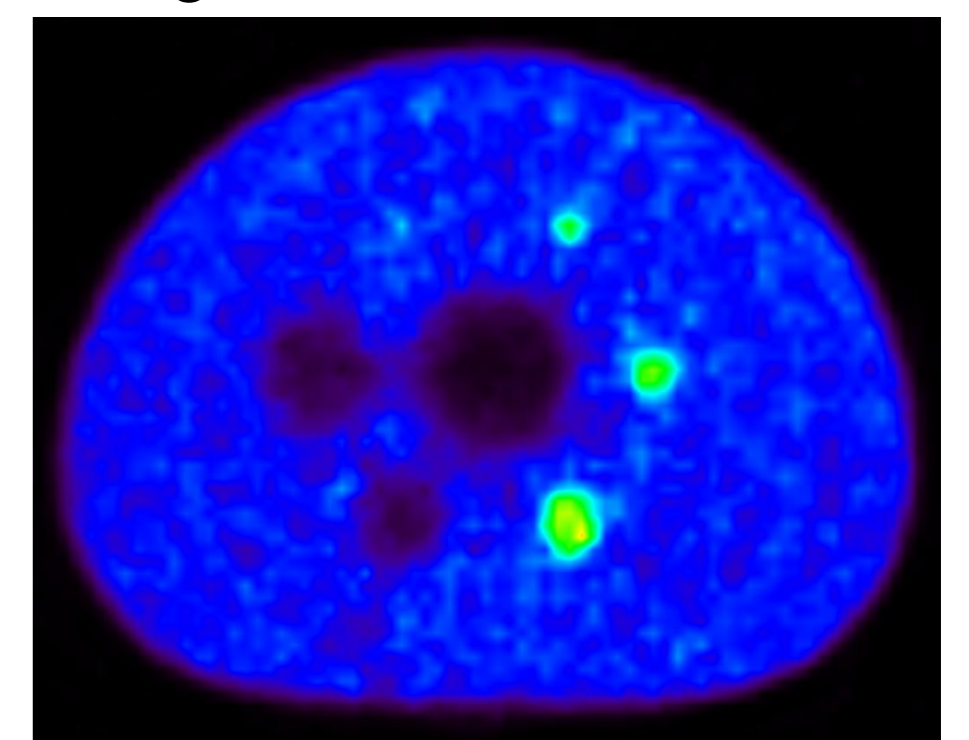
Results:

Reconstruction of NEMA IEQ phantom:

Using reference sensitivity map and proposed implementation are in very good alignment.



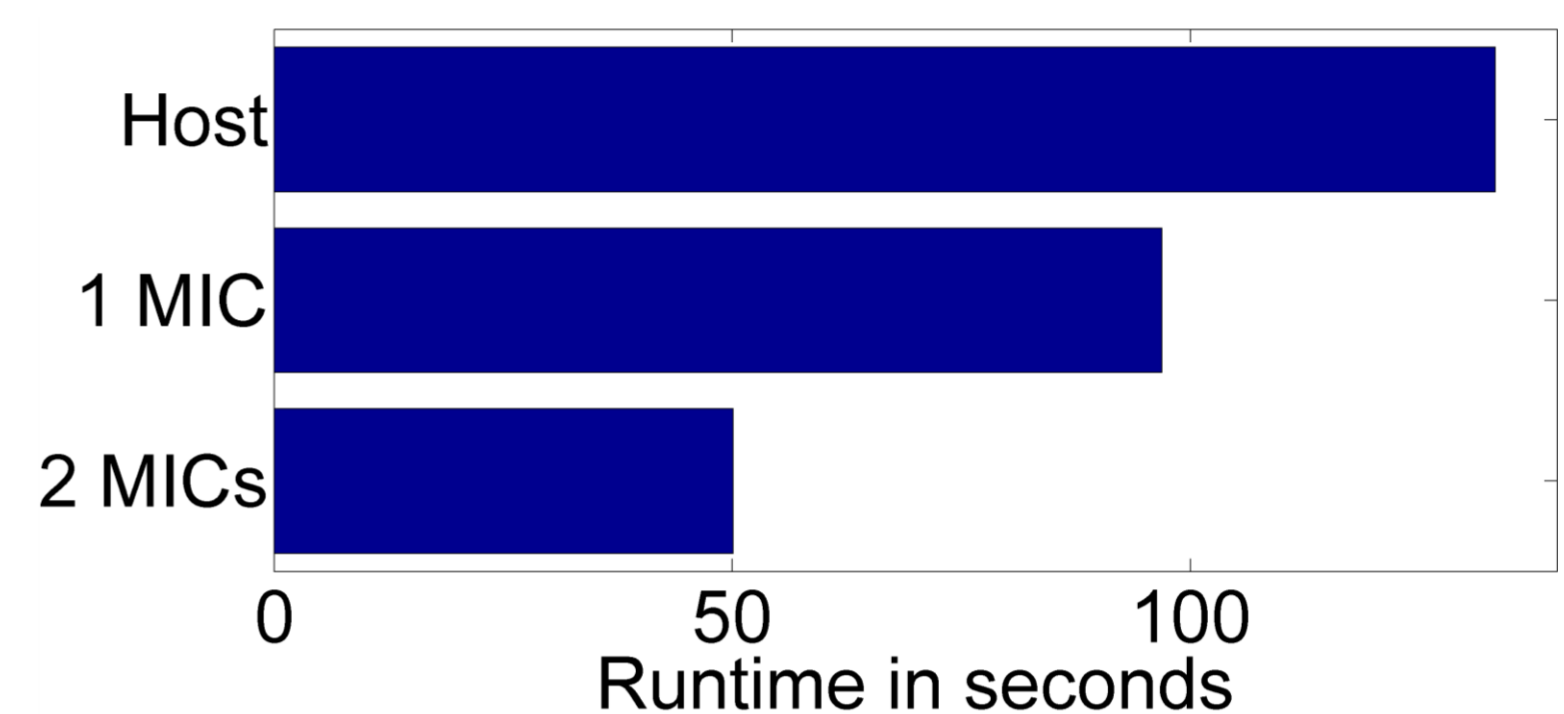
MLEM CPU-only version (ref.)



Proposed implementation (MIC)

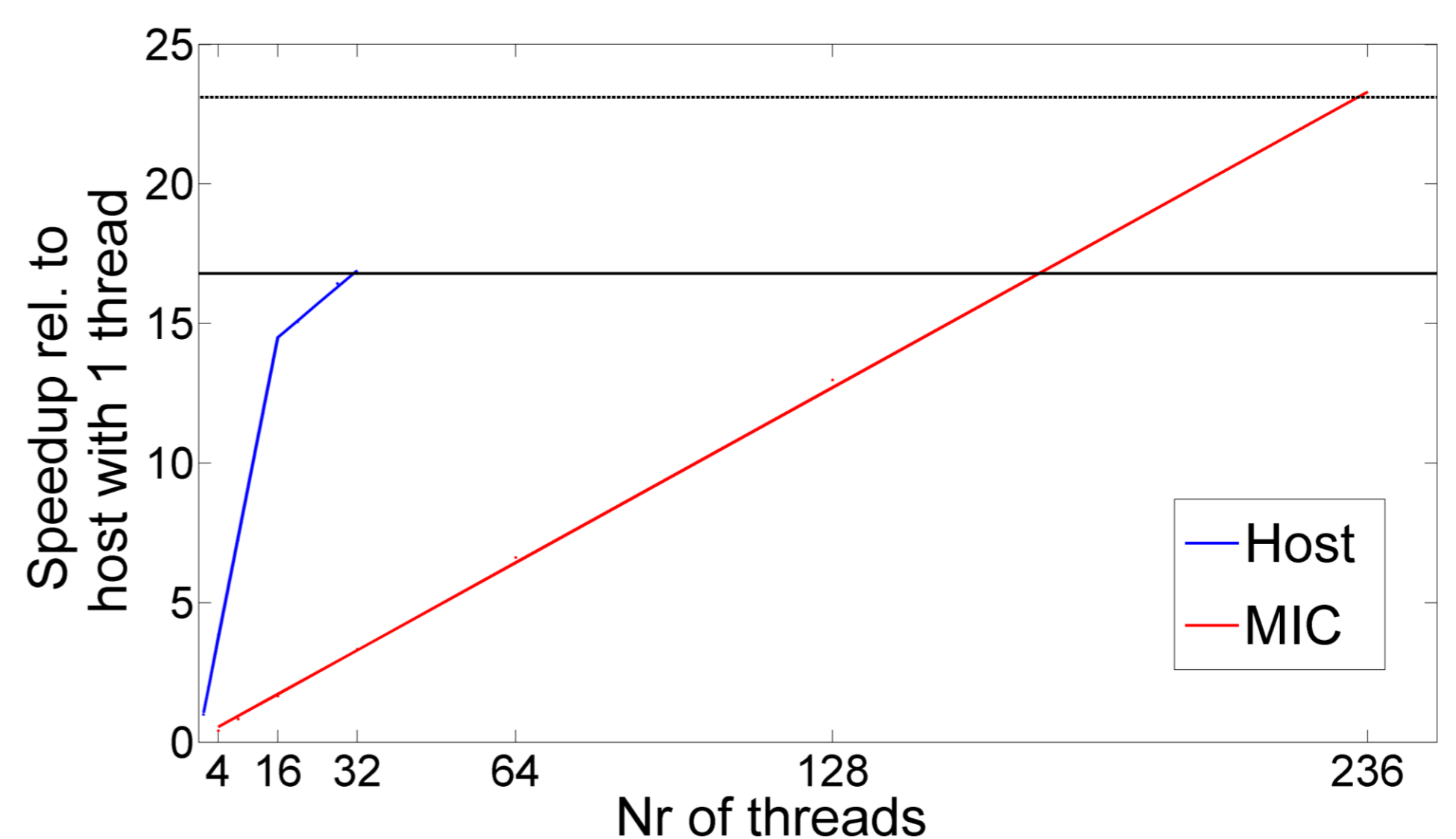
Speedup :

Compared to the host system a speedup of 1.37 or 2.65 can be achieved using one or two MICs.



Scalability factor :

- On host system: 0.90 up to 16 threads and 0.15 above
- On MIC platform: 0.95 up to 236 threads (one core should be used for system management). Note that speedup is normalized to one host thread in the graph below.



Conclusions:

The examination shows a portable implementation for sensitivity map calculation that provides a reasonable speedup on one or two Xeon Phi coprocessors.