Development of a Real-Time Parallel UHF SAR Image Processor

Matthew Alexander, Michael Vai, Thomas Emberley, Stephen Mooney, Joseph Rizzari

HPEC 2010

September 16, 2010

MIT Lincoln Laboratory

Problem Statement

- **Objective: Design and develop a real-time parallel SAR image processing system for rapid integration on an airborne Dash-8 platform**

- **Method: Use Open System Architecture real-time development methodology to produce a parallel image processing system that executes on ruggedized COTS hardware**
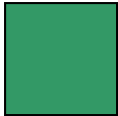

- **Programmatic constraints:**
  - **Size, weight, and power (SWaP)**
    - **1500 lbs, 10kW**
  - **Demanding real-time requirement**
    - **SAR image formation and change detection in less than 10 minutes**
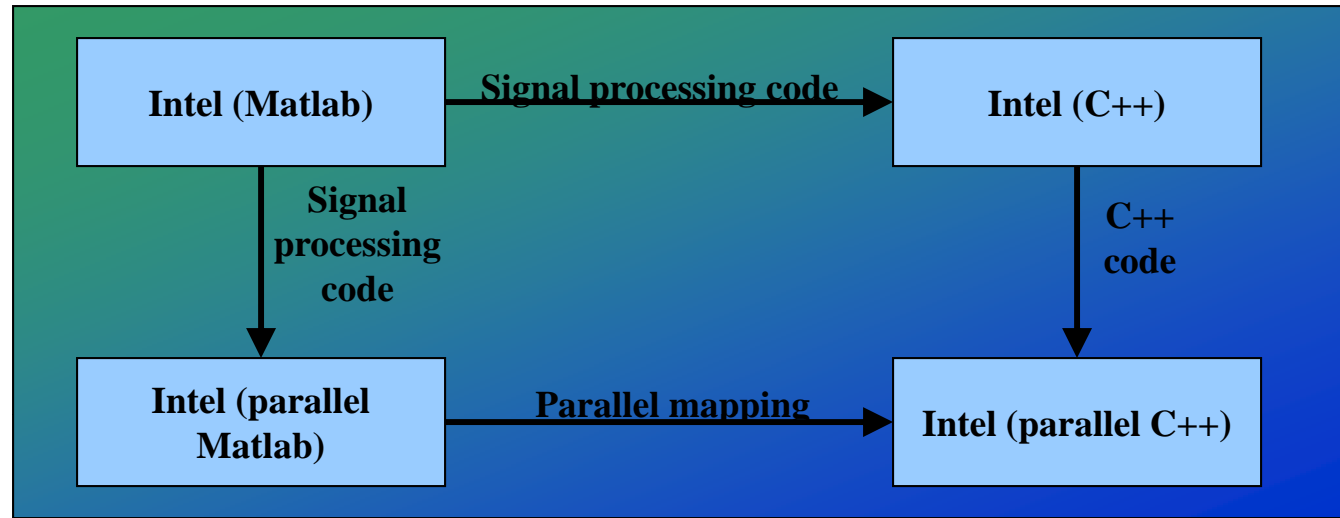 - **Schedule**
    - **18 months**

MIT Lincoln Laboratory

Open Architecture Development Methodology

Focus:

Algorithm development

Computational optimizations

Intel (Matlab)	→ Signal processing code →	Intel (C++)

Signal processing code ↓

C++ code ↓

Intel (parallel Matlab)	→ Parallel mapping →	Intel (parallel C++)

- **Serial processing development:**
  1. **Finalize Matlab signal processing stream**
 2. **Convert Matlab code to serial C/C++ code**

- **Parallel processing development:**
  1. **Parallelize Matlab code using pMatlab to determine optimal mappings**
  2. **Convert serial C/C++ code to parallel C/C++ code (use pMatlab maps)**

> **Open Architecture Development Methodology enables rapid prototyping**
> **Middleware software allows for scalable infrastructure on different hardware configurations**

Results

Intel (Matlab) **10 hours**	→	Intel (C++)
Intel (Parallel Matlab)		Intel (parallel C++) **10 minutes**
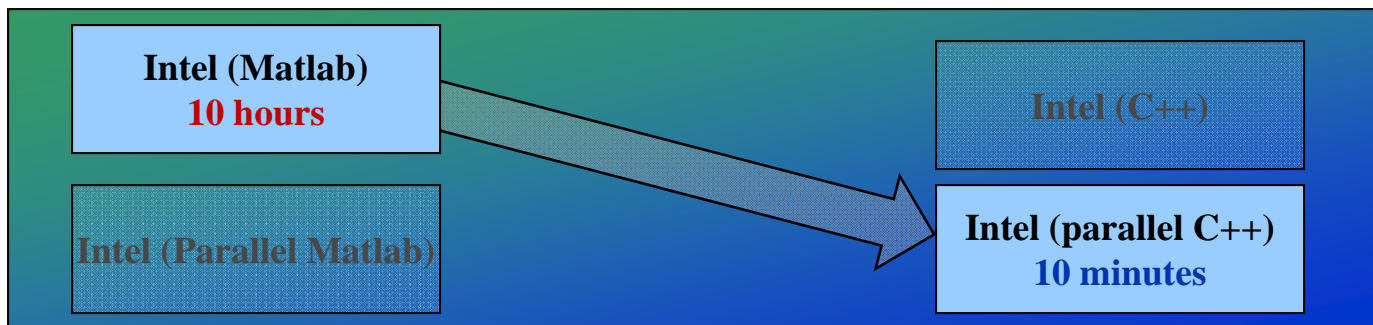
- **136 Intel cores perform real-time image processing within programmatic constraints**
  - **1.632 TFLOPS throughput**
  - **544 Gbytes Memory**
  - **10 Tbytes storage**

Test Strategy →

Software Integration Lab	Systems Integration Lab	Twin Otter	Dash-8

MIT Lincoln Laboratory