

# 選擇 PVF Accelerator 在科學 CUDA

PGI PVF 2010 充分發揮 GPU 計算強度



無痛移轉 Windows Fortran 程式至 GPU 加速元件

## 修改程式簡單

```
do xx=x+1,x+L0
  y = iud(1,xx)
  s = iBC(1,xx)
  do i=1,3
    vs1 = (u(i,1,xx,1)*(-v(1,1,y)+v(1,4,y))+u(i,2,xx,1)*(-v(2,1,y)+v(2,4,y)))
    :
    :
    r(i,4,xx) = v(i,4,xx)*mc - vs1
  end do
end do
end
```

```
!$acc region copyin(u(1:3,1:3,x+1:x+L0,1),v(1:3,1:4,1:x+L0), mc,
!$acc& iud(1,x+1:x+L0), iBC(1,x+1:x+L0)), copyout(r(1:3,1:4,x+1:x+L0))
!$acc do kernel private(vs1(1:3),vs2(1:3))
do xx=x+1,x+L0
  y = iud(1,xx)
  s = iBC(1,xx)
  do i=1,3
    vs1 = (u(i,1,xx,1)*(-v(1,1,y)+v(1,4,y))+u(i,2,xx,1)*(-v(2,1,y)+v(2,4,y)))
    :
    :
    r(i,4,xx) = v(i,4,xx)*mc - vs1
  end do
end do
!$acc end region
end
```

## 使用容易

```
FC = gfortran
FFLAGS = -O2 -fopenmp -Wall -frecord-marker=4

SRC := init.f cg.f check.f ulink.f lvv.f wilson.f wilsonD.f

OBJ := $(SRC:.f=.o)
... ..
$(BIN): $(OBJ)
$(FC) $(FFLAGS) -o $$@ $(OBJ)
... ..
```

```
FC = pgf90
FFLAGS = -fast -Minfo=all,accel -ta=nvidia -Mcuda=keepgpu

SRC := init.f cg.f check.f ulink.f lvv.f wilson.f wilsonD.f

OBJ := $(SRC:.f=.o)
... ..
$(BIN): $(OBJ)
$(FC) $(FFLAGS) -o $$@ $(OBJ)
... ..
```

## 方便產生高效能 NVIDIA CUDA 語言

```
#include "cuda_runtime.h"
#include "pgi_cuda_runtime.h"

struct DT2_80{signed char* m0;signed char* m8;char fill1[8];};
struct DT2_88{long long m0;long long m8;long long m16;signed char* m24;signed char* m32;signed char* m40;struct DT2_80* m48;struct DT2_80* m56;struct DT2_80* m64;char fill1[8];};
... ..
{double _d_1, _d_2, _d_3, _d_4, _d_5, _d_6;
dcmplx x7;
... ..
_BB_21: ;
*(double*)((a2.p6)+((((3)*((4)*(i3)))+(j120))*(16))+ (8))) = (*(double*)((a2.p6)+((((3)*((4)*(i3)))+(j120))*(16))+ (8))))+(x8[1]);
... ..
```

## 完整 Fortran 編譯功能

### 編譯功能 -

- Native OpenMP and auto-parallel Fortran 95/03 compiler with optional support for PGI Accelerator directives and CUDA extensions
- Full 64-bit support on AMD64, Intel 64 and NVIDIA CUDA-enabled GPUs
- PGI Unified Binary technology—combine code optimized for multiple AMD64 processors, Intel 64 processors or NVIDIA GPUs into a single executable file
- Auto-parallelization
- OpenMP 3.0 parallelization
- Inter-language calling
- Vectorization/Optimization directives
- Integrated cpp pre-processor
- Compile-time optimization listings
- Annotated assembly code listings
- Comprehensive support for Fortran 2003

### 提供程式最佳化工具 -

- AMD64 and Intel 64 cross-target optimization
- Interprocedural Analysis (IPA)
- Scalar SSE code generation
- Function inlining
- Loop fusion
- Profile feedback optimization
- Memory hierarchy and allocation optimization
- Instruction scheduling
- Global constant propagation
- Global dependence analysis
- Global flow analysis
- Integrated local, global and vector register allocation
- Induction varanalysis
- Load/store analysis
- Scalar expansion, scalar replacement
- Dead code elimination

### 向量 / 平行化轉換選項 -

- State-of-the-art dependence analysis
- Nested loop auto-parallelization
- Nested loop vectorization
- Aligned access optimizations
- Scalar promotion
- Temporary vector creation
- Concurrent call support
- Inline concurrent code segments
- Vector SSE code generation
- Software prefetching

## 融入微軟 Visual Studio 環境：

- Fortran syntax coloring
- Fortran intrinsics tips
- Keyword completion
- Fortran debug engine
- Automatic dependency analysis
- Interoperable with Microsoft Visual C++
- Sample projects
- Bundled Visual Studio 2010 IDE
- Bundled ACML math library
- Supports multi-threaded execution with Intel MKL 10.1 and later
- Optional IMSL Fortran numerical library available
- Build, launch and debug Microsoft MPI (MSMPI) applications

## 平行程式除錯引擎：

- 64-bit and 32-bit targets
- Debug Fortran and Visual C++
- Debug single and multi-thread, parallel OpenMP, multi-thread MSMPI and hybrid MSMPI+OpenMP programs
- Variable roll-over
- One touch breakpoint setting
- Step into, over, out of functions
- Attach to running processes
- Traceback, Log files, Help
- One touch symbolic display
- Multiple format display of values/strings
- Track register states

### 系統需求：

**處理器：** 64 位元 AMD64, 64 位元 Intel 64 或 32 位元 x86 多核心處理器

**加速器：** 可執行 CUDA 的 NVIDIA GPU 加速器

### 支援作業系統：

**Visual Studio 2010** - 64 位元或 32 位元 Windows 7, Windows Vista SP1, Windows XP Professional x64 SP2, Windows XP SP3, Windows Server 2008 SP1, Windows Server 2008 R2, Windows Server 2003 SP2, Windows Server 2003 R2 SP2

**Visual Studio 2008** 或 **Visual Studio 2005** - 64 位元或 32 位元 Windows 7, Vista, XP, Windows Server 2008, Windows Server 2003