\[ \diamond \varnothing \dashv \forall \varphi \in \mathcal{A} \implies \forall \alpha \in \mathcal{A} \implies \forall \beta \in \mathcal{A} \implies \forall \gamma \in \mathcal{A} \implies \varnothing \]
\[ \frac{1}{\epsilon} = \sum_{j=0}^{\infty} \epsilon^j \]
\[ f(x) = f(x) \]
\[ b_i = \left[ \frac{a}{a_{i+1}} \right] \]
\[ a_i = a \mod a_{i+1}. \]

ENDFOR

\[
\begin{align*}
T &= T + 1, \\
UU &= UU + \{U_i^T\}, \\
D &= U_i^T D \\
\end{align*}
\]

\[
\begin{align*}
e_{t+1} &= -b_t e_{t+1} - \ldots - b_1 e_{t+1} + \epsilon_{t+1}.
\end{align*}
\]

\[
\begin{align*}
\text{ENDWHILE}
\end{align*}
\]

\[
\begin{align*}
E_0 &= E_0 + \{0\}, E_2 = E_2 - \{e_{t+1}\}, e = e + 1.
\end{align*}
\]

ENDDIF

ENDFOR

(4) \[ U = U_T U_{T-1} \ldots U_1 \in \mathbb{E}^n \times \mathbb{E}^n, \]
\[ U_T U_{T-1} \ldots U_1 \in U \in U. \]

\[
\begin{align*}
\text{ENDWHILE}
\end{align*}
\]
\[
\min(100, \left\lfloor \frac{-(j2)}{5} \right\rfloor, \left\lfloor \frac{(j1+3 \times j2)}{2} \right\rfloor)
\]

\[
i1 = j3
\]

\[
i2 = j1 + 3 \times j2 - j3
\]

\[
i3 = j1 + 2 \times j2 - 5 \times j3
\]

\[
a(i1+1,i2+3,i3+2) = \ldots
\]

\[
\ldots = a(i1,i2+1,i3+5)+a(i1+1,i2,i3)
\]

ENDDO

ENDDO

ENDDO

3 \[ \Omega : - \varepsilon \]

4 \[ \begin{align*}
\sum_{i \leq 0} & \left( \sum_{i \leq 0} f(i) \right) \leq 0 \quad \text{for all } \varepsilon \geq 0
\end{align*} \]

5 \[ \begin{align*}
\end{align*} \]

6 \[ \begin{align*}
\end{align*} \]

7 \[ \begin{align*}
\end{align*} \]

8 \[ \begin{align*}
\end{align*} \]

9 \[ \begin{align*}
\end{align*} \]

10 \[ \begin{align*}
\end{align*} \]

11 \[ \begin{align*}
\end{align*} \]

Automatically Computing Unimodular Transforming Matrix to Parallelize Nested Sequential Loops

YU Yi-jun ZANG Bin-yu SHI Wu ZHU Chuan-qi

(Institute of Parallel Processing Fudan University Shanghai 200433)

Abstract Lacking an effective and feasible algorithm to compute the valid unimodular matrix for parallelizing of the outer loops, previous parallelizing researches can not automatically reveal the parallelism in such sequential nested-loops as have n-dimension distance matrix. In this paper, the authors discuss a general outer-loop parallelizing method by valid unimodular transformations, prove the existence of such a valid unimodular transformation, and suggest several practical computing algorithms through the constructive proofs. This discovered unimodular transformation can have the maximal number of parallelizable outer-loops transformed. Thus, the application scope of the algorithms can be enlarged to non-perfect or non-constant dependence distance loops.

Key words Dependence test, automatic parallelizing transformation, unimodular transformation.