Fault Tolerant Solutions to the Firing Squad Synchronization Problem

Jean-Baptiste Yunès
LITP – IBP
Université Paris 7 – Denis Diderot
France

Plan

CA, LCA, FLCA

FSSP

Faulty CA

Freezed CA

Fault Tolerant FSSP :

H. Umeo, J.B. Yunès

CA

CA : Cellular Automata :

- finite automata,
- inputs, outputs,
- synchronism,
- transition function,
- finite set of states, quiescent state,
- cells, configuration,
- space-time diagram.

LCA : Linear Cellular Automata : line of automata,

FLCA : Finite Linear Cellular Automata : finite line of automata,

FSSP

starting configuration :

- one general,
- quiescent soldiers.

synchronizing configuration :

- firing soldiers.

conditions on the computation :

- no firing soldiers before synchronization.

Faulty CA

H. Umeo :

- self-diagnosis circuitry,
- faulty and non-faulty cell/regions,
- computation in faulty cells,
- detecting faulty and non-faulty regions,

Freezed CA

Freezing process : a mechanism which permits the computation to be stopped for a good while.

Thawing process : a mechanism which permits a freezed computation to be warmed up.

Fault Tolerant FSSP

H. Umeo :

1. FLCA synchronizing a p-faulty n-line in $2n-2$ steps (minimal time) : p is known and $\forall i \in [1,p]$, $n_i \geq m_i$,

2. FLCA synchronizing a p-faulty n-line in $2n-2+p$ steps (nearly minimal time) : p is unknown, $\forall i \in [1,p]$, $n_i \geq m_i \wedge n_i + m_i \geq p-i$.

Fault Tolerant FSSP

Reversing Umeo's conditions

1. FLCA synchronizing a 1-faulty n-line in $2n-2+m_1-n1$ steps: $m_1 \geq n_1$,

2. FLCA synchronizing a 2-faulty n-line in $2n-2+m_1-n_1+m_2-n_2$ steps: $m_1 \geq n_1$ and $m_2 \geq n_2$,

3. FLCA synchronizing a p-faulty n-line in $2n-2+\sum_{i=1}^{i=p}(m_i-n_i)$ steps: p is known and $\forall i \in [1,p]$, $m_i \geq n_i$,

Standardization

– $\forall i \in [1,p]$, $n_i \geq m_i \vee n_i < m_i$