2. Granularity
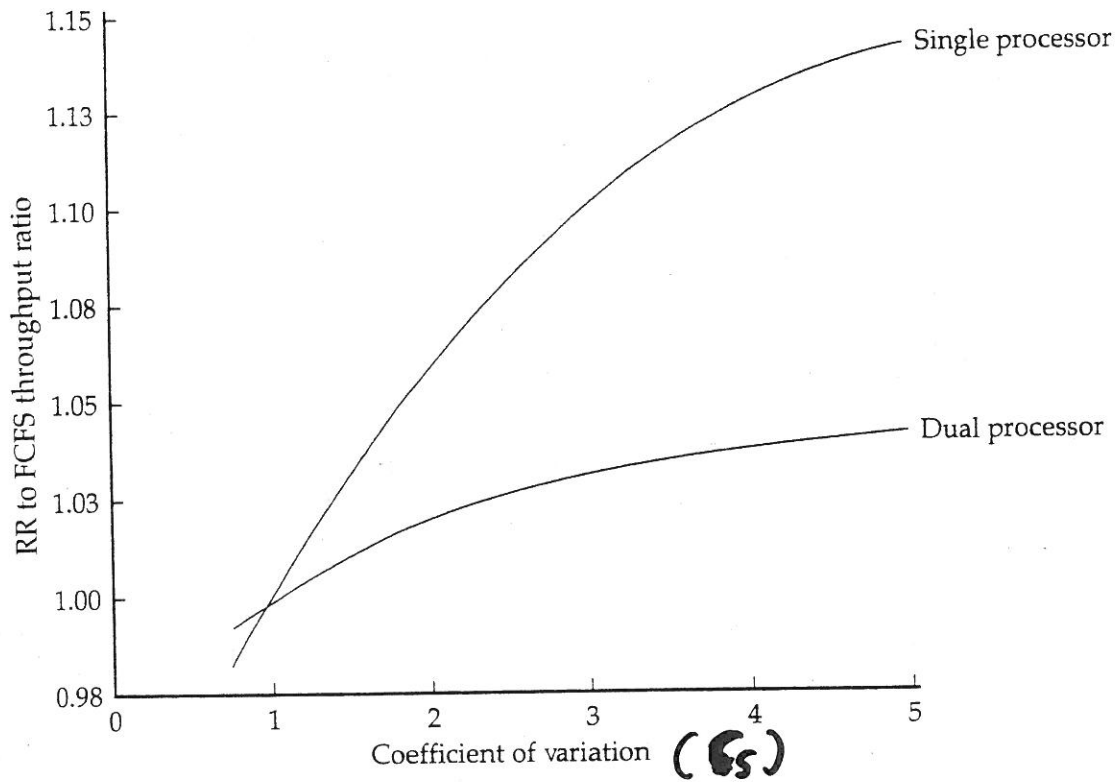
- **Granularity:** frequency of synchronization between processes in a system.

Table 10.1 Synchronization Granularity and Processes
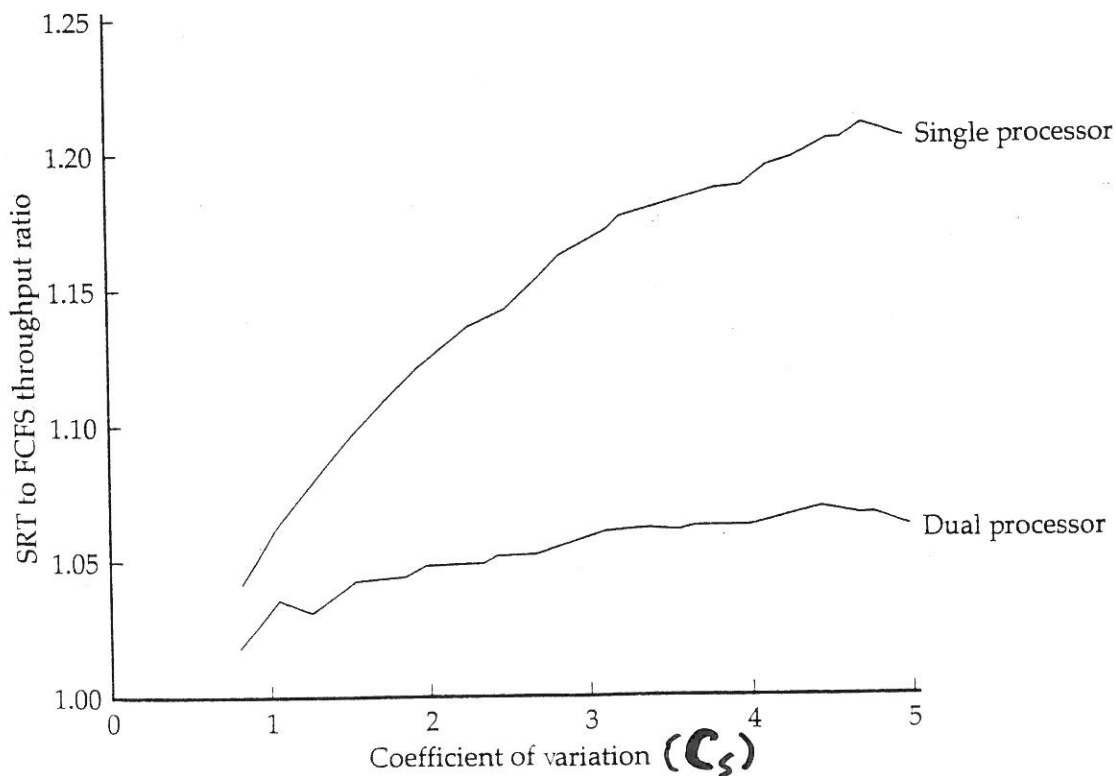
Grain Size	Description	Synchronization Interval (Instructions)
Fine	Parallelism inherent in a single instruction stream	< 20
Medium	Parallel processing or multitasking within a single application	20–200
Coarse	Multiprocessing of concurrent processes in a multiprogramming environment	200–2000
Very coarse	Distributed processing across network nodes to form a single computing environment	2000–1M
Independent	Multiple unrelated processes	(N/A)

$$C_S = \frac{\sigma_S}{T_S}, \quad \sigma_S - \text{standard variation of service time}$$
$$T_S - \text{mean service time}$$

(a)

(b)

Figure 10.1 Comparison of Scheduling Performance for One and Two Processors
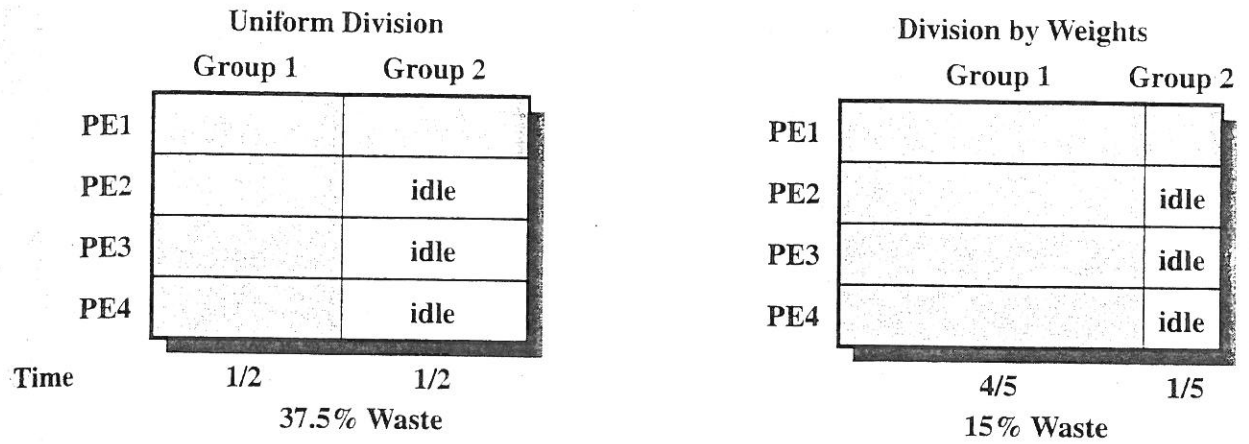
Uniform Division

	Group 1	Group 2
PE1		
PE2		idle
PE3		idle
PE4		idle
Time	1/2	1/2

37.5% Waste

Division by Weights

	Group 1	Group 2
PE1		
PE2		idle
PE3		idle
PE4		idle
	4/5	1/5

15% Waste

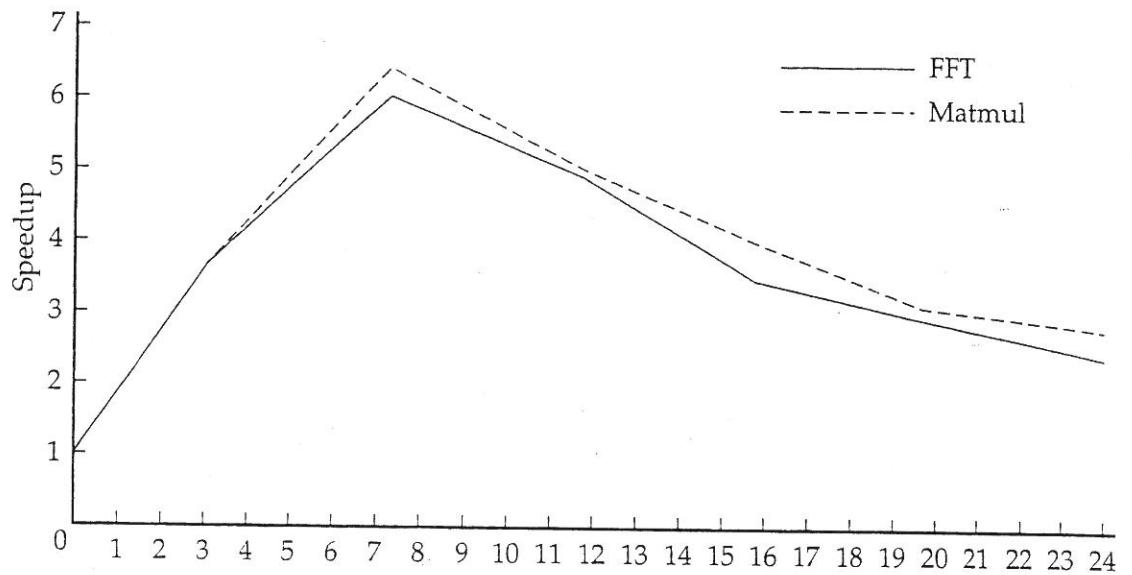**Figure 10.2** Example of Scheduling Groups with Four and One Threads [FEIT90a]

Figure 10.3   Application Speedup as a Function of Number of ~~Processes~~ Threads [TUCK89]

System: 16 processors

2 applications: Matrix Multiplication
FFT

Each application is implemented with
1 — 24 threads