從信號與系統到控制

單元：摺積操作性質 - 7

交換律 分配律 結合律 與 系統的關係

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單元學習目標與大綱

- 交換律 分配律 結合律 之 操作法則 與
- 系統 輸入 與 輸出 之間的關係
- 多個系統 運作的關係

摺積計算操作 之 交換律

$$x[n] * h[n] = h[n] * x[n]$$

$$x(t) * h(t) = h(t) * x(t)$$

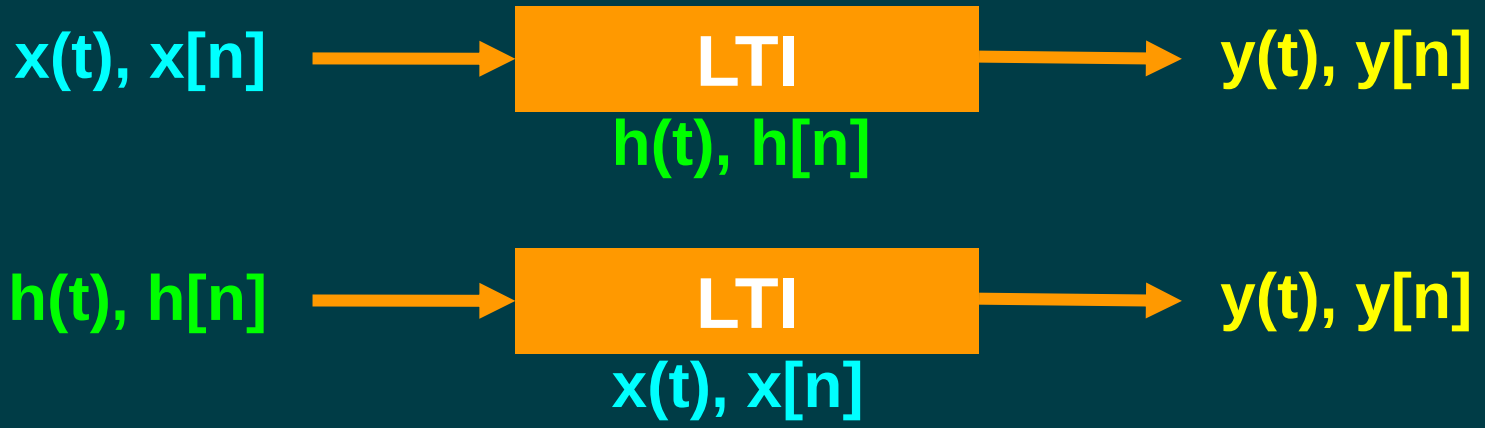
$$y[n] = x[n] * h[n] \qquad y[n] = h[n] * x[n]$$

$$y(t) = x(t) * h(t) \qquad y(t) = h(t) * x(t)$$

摺積計算操作 之 交換律

$$y[n] = x[n] * h[n] \qquad y[n] = h[n] * x[n]$$

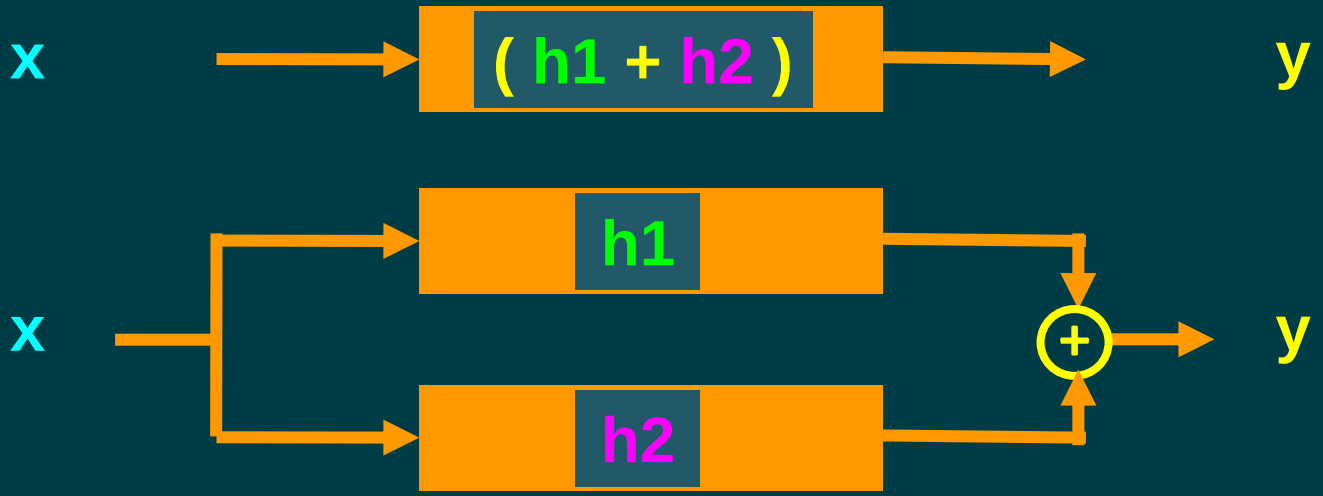
$$y(t) = x(t) * h(t) \qquad y(t) = h(t) * x(t)$$



摺積計算操作 之 分配律

$$x[n] * (h1[n] + h2[n]) = x[n] * h1[n] + x[n] * h2[n]$$

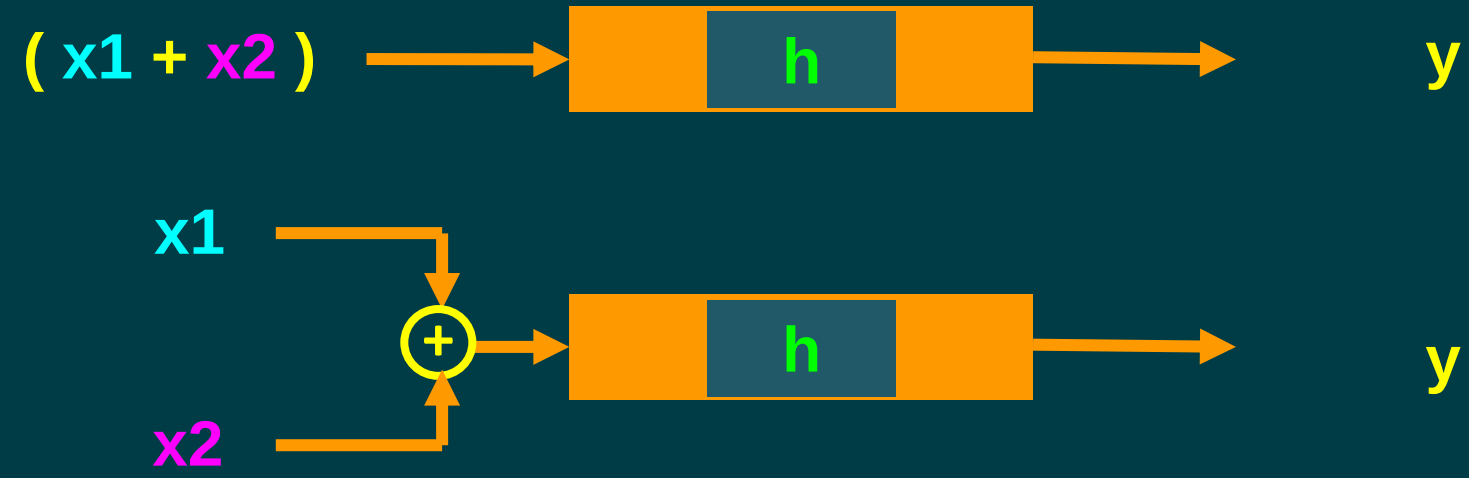
$$x(t) * (h1(t) + h2(t)) = x(t) * h1(t) + x(t) * h2(t)$$



摺積計算操作 之 分配律

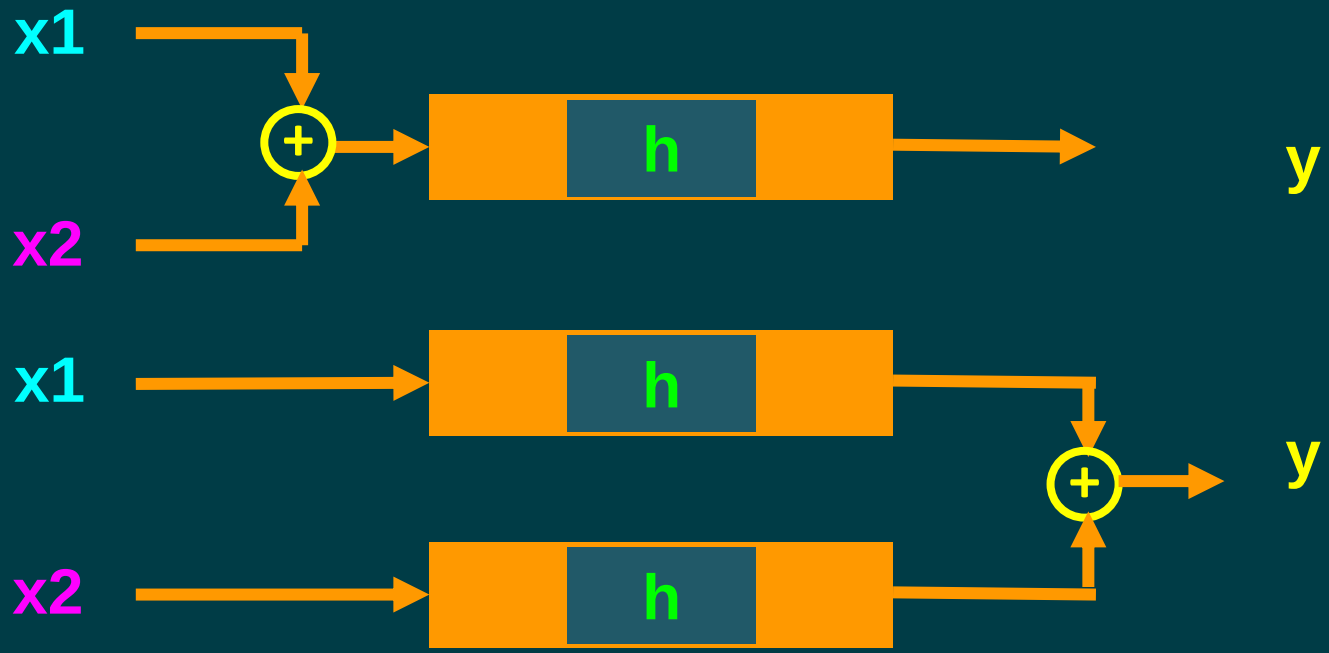
$$(x1[n] + x2[n]) * h[n] = x1[n] * h[n] + x2[n] * h[n]$$

$$(x1(t) + x2(t)) * h(t) = x1(t) * h(t) + x2(t) * h(t)$$



摺積計算操作 之 分配律

$$(x1 + x2) * h = x1 * h + x2 * h$$



摺積計算操作 之 結合律

$$a[n] * (b[n] * c[n]) = (a[n] * b[n]) * c[n]$$

$$a(t) * (b(t) * c(t)) = (a(t) * b(t)) * c(t)$$

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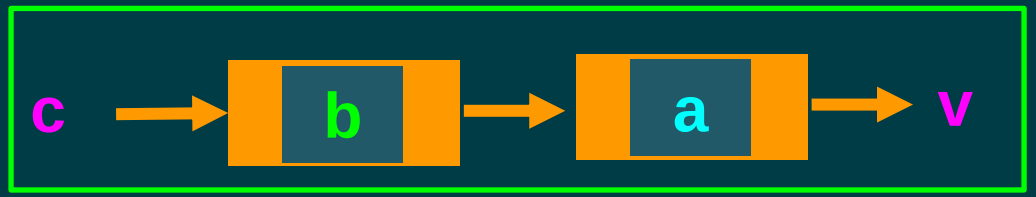
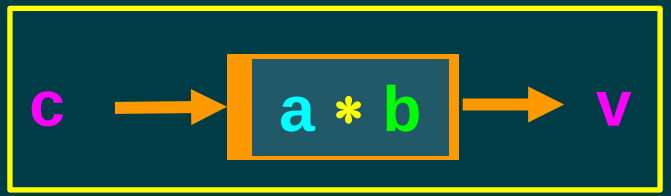
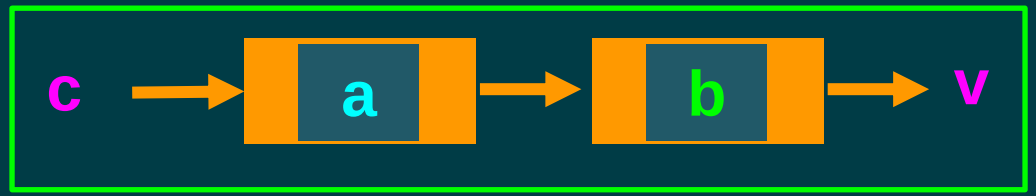
摺積計算操作 之 結合律

$$a * (b * c) \quad = \quad (a * b) * c$$







交換律 分配律 結合律 與系統的關係

- 交換律 (Commutative)

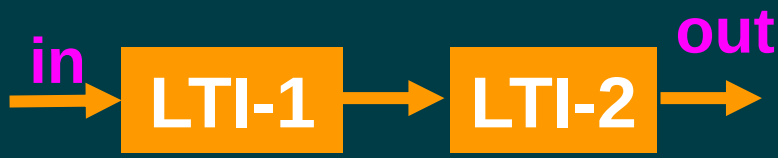
  $x * h = h * x$

- 分配律 (Distributive)

  $y * (x + h) = y * x + y * h$

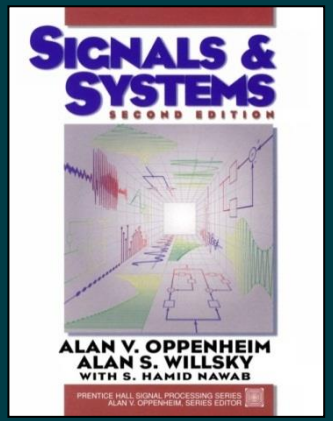
- 結合律 (Associative)

  $y * (x * h) = (y * x) * h$



參考文獻

- Alan V. Oppenheim, Alan S. Willsky, S. Hamid,
  Signals & Systems,
  Prentice Hall, 2nd Edition, 1997



- **SciLab**:
  Open source software for numerical computation
  http://www.scilab.org/