NTNU – Trondheim
Norwegian University of
Science and Technology

TTT4120 Digital Signal Processing
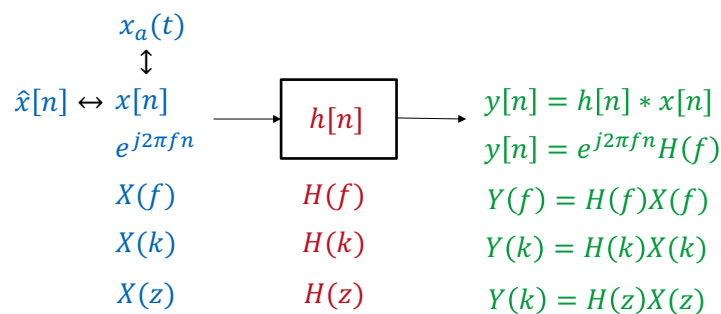**Fall 2021**

Lecture: Epilogue

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Three-page summary (Part I)

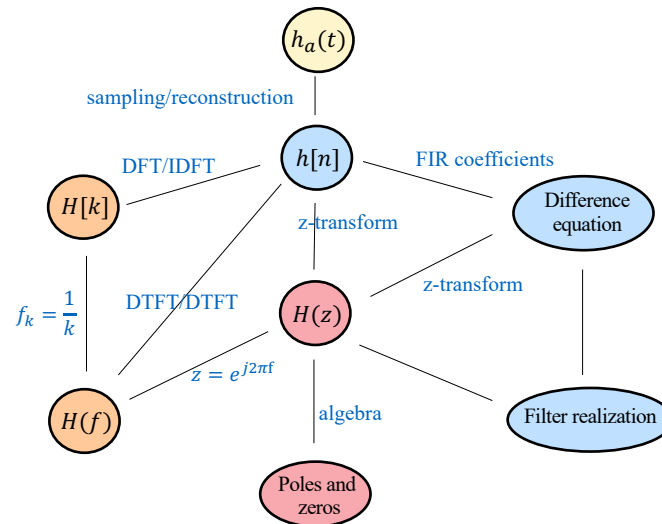- Deterministic signals (time and frequency) and LTI systems

$$x_a(t)$$
$$\updownarrow$$
$$\hat{x}[n] \leftrightarrow x[n] \longrightarrow \boxed{h[n]} \longrightarrow y[n] = h[n] * x[n]$$
$$e^{j2\pi fn} \qquad\qquad\qquad y[n] = e^{j2\pi fn}H(f)$$

$$X(f) \qquad H(f) \qquad Y(f) = H(f)X(f)$$
$$X(k) \qquad H(k) \qquad Y(k) = H(k)X(k)$$
$$X(z) \qquad H(z) \qquad Y(k) = H(z)X(z)$$

- System analysis and design, convolution, frequency analysis, sampling and reconstruction, correlation, implementation,…

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Three-page summary (Part I)...

- $h_a(t)$
- sampling/reconstruction
- DFT/IDFT
- $h[n]$
- FIR coefficients
- $H[k]$
- Difference equation
- z-transform
- $f_k = \frac{1}{k}$
- DTFT/DTFT
- $H(z)$
- z-transform
- $z = e^{j2\pi f}$
- algebra
- Filter realization
- $H(f)$
- Poles and zeros

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Three-page summary (Part II)

- Stochastic signals (time and frequency) and LTI systems

$$X[n] \longrightarrow \boxed{h[n]} \longrightarrow Y[n] = h[n] * X[n]$$

$\hat{\gamma}_{XX}[l] \leftrightarrow \gamma_{XX}[l]$ $\gamma_{YY}[l] = r_{hh}[l] * \gamma_{XX}[l]$

$\hat{\Gamma}_{XX}(f) \leftrightarrow \Gamma_{XX}(f)$ $H(f)$ $\Gamma_{YY}(f) = |H(f)|^2 \Gamma_{XX}(f)$

$\Gamma_{XX}(z)$ $H(z)$ $\Gamma_{YY}(z) = H(z)H(z^{-1})\Gamma_{XX}(z)$

- Estimation, filtering of stochastic signals, power spectrum, modeling (parametric and nonparametric), interference suppression, prediction

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Guidelines for exam

- In the exam, the basic idea is to evaluate the understanding of *principles* of central ideas, not just memorizing details
- Details are useless if the big picture is not clear!
- Equations etc. needed in solving of a mathematical problem are usually given in the problem setting
- Concentrate on understanding why!

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Office hours for exam questions

- We will arrange virtual QA sessions

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