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Voltage Dip Characteristics through the Ellipse Parameters

Big What is voltage dip?

Voltage dips, also called "voltage sags", are short-duration reductions in voltage magnitude.

Space Phasor Model

The Space Phasor Model (SPM) of three phase voltages, V_a, V_b and V_c, is obtained by:

$$\text{SPM} = \frac{2}{3}[V_a(t) + \alpha V_b(t) + \alpha^2 V_c(t)]$$

where $\alpha = e^{j2\pi/3}$ and $\alpha^2 = e^{j4\pi/3}$.

Single-Event Characteristics

➢ The characteristic voltage (CV) is equivalent of residual voltage.

➢ The positive-negative factor (PNF) measures the amount of voltage unbalance.

➢ The dip type (DT) distinguishes between balanced and unbalanced voltage dips.

Ellipse parameters

1. Semi-minor axis is a good approximation of CV.
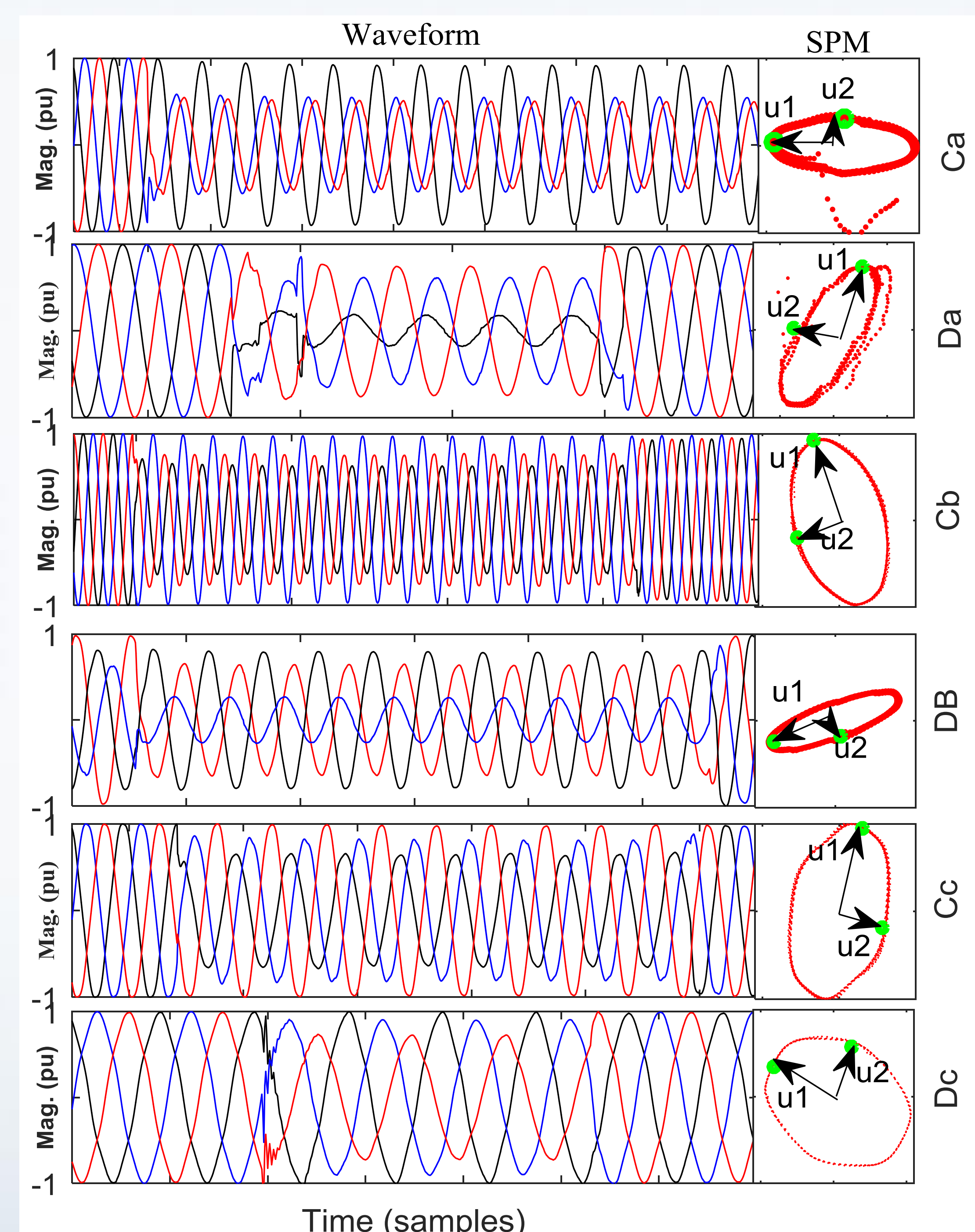
$$CV \approx A_y$$

2. Semi-major axis is a good approximation of PNF.

$$PNF \approx A_x$$

3. The rotating angle of ellipse, semi-major axis direction, indicates the dip type using parameter T.

$$T = ceil\left(\frac{\varphi}{30}\right)$$

$T = 1;$	Type D_b
$T = 2;$	Type C_c
$T = 3;$	Type D_a
$T = 4;$	Type C_b
$T = 5;$	Type D_c
$T = 6;$	Type C_a

[1] L. Zhang, M. Bollen, "Characteristic of voltage dips in power systems", *IEEE Trans. Power Delivery*, vol. 15, pp. 827-832, Apr. 2000.
[2] V. Ignatova, P. Granjon, S. Bacha, "Space vector method for voltage dips and swells analysis", *IEEE Trans. Power Delivery*, vol. 24, pp. 2054-2061, Oct. 2009.

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