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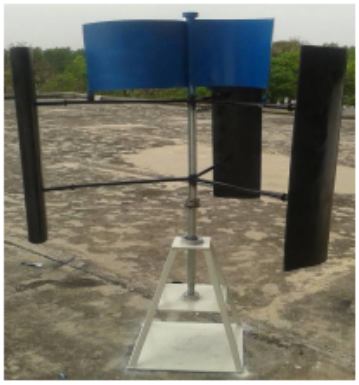
ALGORITHM OF WIND TURBINE COMBINED ROTOR AERODYNAMICS CALCULATION

Abstract *The paper is devoted to the vertical axis wind turbines with combined rotors aerodynamical modelling. It includes the analysis of existing wind turbine types, their advantages and disadvantages. The article includes reasoning for combined rotor with vertical axis of rotation building and includes new aerodynamic calculation method*

Index Terms

H



$$\frac{\partial u_j}{\partial x_j} =$$

$$\frac{\partial u_j}{\partial t} + \frac{\partial \left(u_j u_i \right)}{\partial x_j} = -\frac{\partial p}{\partial x_i} + \frac{\partial}{\partial x_j} \left[\nu_f \left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} \right) \right]$$

$x_i \; i =$ $x \; y \quad t$

u_i $u \; v$

p ρ

$\nu \quad = \nu + \nu_t$

ν ν_t

$$\frac{\partial U_x}{\partial t}+\frac{\partial\left(U_x\right)}{\partial x}+\frac{\partial\left(U_xU_y\right)}{\partial y}=-\frac{\partial p}{\partial x}+\frac{\partial}{\partial x}\left[\nu_{eff}\left(\frac{\partial U_x}{\partial x}\right)\right]+\frac{\partial}{\partial y}\left[\nu_{eff}\left(\frac{\partial U_x}{\partial y}+\frac{\partial U_y}{\partial x}\right)\right]$$

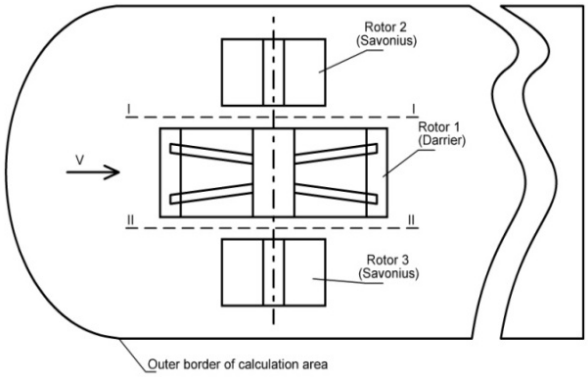
$$\frac{\partial U_y}{\partial t}+\frac{\partial\left(U_yU_x\right)}{\partial x}+\frac{\partial\left(U_y\right)}{\partial y}=-\frac{\partial p}{\partial y}+\frac{\partial}{\partial x}\left[\nu_{eff}\left(\frac{\partial U_y}{\partial x}+\frac{\partial U_x}{\partial y}\right)\right]+\frac{\partial}{\partial y}\left[\nu_{eff}\left(\frac{\partial U_y}{\partial y}\right)\right]$$

$$\frac{\partial U_x}{\partial y}+\frac{\partial U_y}{\partial x}=$$

$U_x \quad U_y$ $x \qquad y$

$U_\infty \quad p_\infty$

$U_x = U_\infty \quad U_y = \quad p = p_\infty$



$\vec{U}_{x\ y\in G}=\vec{\omega}\times\vec{r} \quad \left(\frac{\partial p}{\partial n}\right)_{x\ y\in G}=$

$\vec{r}=\{x \quad y\}$

n

$U_x = U_\infty \quad U_y = \quad p = p_\infty$

$\frac{\partial U_x}{\partial x}= \quad \frac{\partial U_y}{\partial y}= \quad \frac{\partial p}{\partial x}= \quad \frac{\partial p}{\partial y}=$

$\frac{\partial U_x}{\partial n}= \quad \frac{\partial U_y}{\partial n}= \quad \frac{\partial p}{\partial n}=$

n

$U_x=\left(U_x\right) \quad U_y=\left(U_y\right) \quad p=p$

$\frac{\partial U_x}{\partial x}=\left(\frac{\partial U_x}{\partial x}\right) \quad \frac{\partial U_y}{\partial x}=\left(\frac{\partial U_y}{\partial x}\right) \quad \frac{\partial p}{\partial x}=\left(\frac{\partial p}{\partial x}\right)$

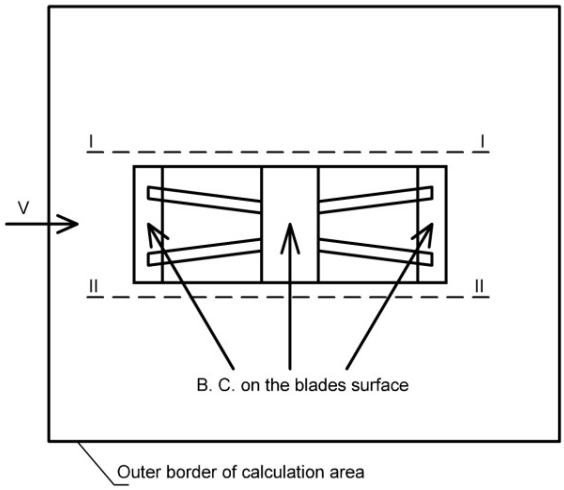
$\frac{\partial U_x}{\partial y}=\left(\frac{\partial U_x}{\partial y}\right) \quad \frac{\partial U_y}{\partial y}=\left(\frac{\partial U_y}{\partial y}\right) \quad \frac{\partial p}{\partial y}=\left(\frac{\partial p}{\partial y}\right)$

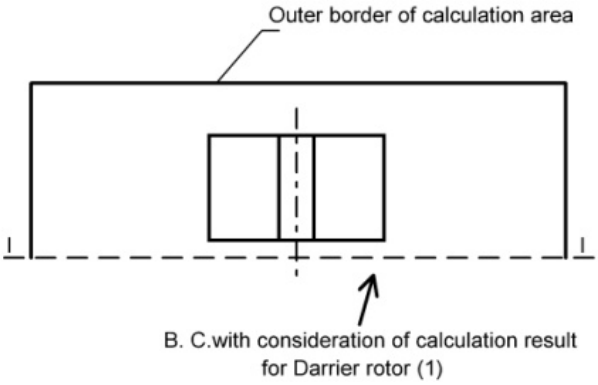
$$U_x = (U_x) \qquad U_y = (U_y) \qquad p = p$$

$$\frac{\partial U_x}{\partial x} = \left(\frac{\partial U_x}{\partial x}\right) \qquad \frac{\partial U_y}{\partial x} = \left(\frac{\partial U_y}{\partial x}\right) \qquad \frac{\partial p}{\partial x} = \left(\frac{\partial p}{\partial x}\right)$$

$$\frac{\partial U_x}{\partial y} = \left(\frac{\partial U_x}{\partial y}\right) \qquad \frac{\partial U_y}{\partial y} = \left(\frac{\partial U_y}{\partial y}\right) \qquad \frac{\partial p}{\partial y} = \left(\frac{\partial p}{\partial y}\right)$$

$C_y \quad f$ $C_x \quad f$





$$\frac{d}{dx} A U_{j\,k} + \quad U_{j\,k-} + U_{j\,k} \quad V_{j\,k-} + V_{j\,k} \quad x_B - x_A \quad + k \frac{U_{j\,k-} - U_{j\,k}}{y_k - y_{k-}} \quad x_B - x_A$$

$$- \quad k \; V_{j\,k-} + V_{j\,k} \quad + \quad U_{j+\;k} + U_{j\,k} \quad y_c - y_B \quad + \quad p_{j+\;k} + p_{j\,k} \quad y_c - y_B$$

$$+ \quad k \frac{U_{j+\;k} - U_{j\,k}}{x_{j+} - x_j} \quad y_c - y_B \quad - \quad k \; V_{j+\;k} + V_{j\,k} \quad + \quad U_{j\,k+} + U_{j\,k}$$

$$\cdot \; V_{j\,k+} + V_{j\,k} \quad x_C - x_D \quad + k \frac{U_{j-\;k+} - U_{j-\;k}}{y_{k+} - y_k} \quad x_C - x_D \quad - \quad k \; V_{j\,k+} + V_{j\,k}$$

$$+ \quad U_{j-\,k} + U_{j\,k} \quad y_D - y_A \; + \quad p_{j-\,k} + p_{j\,k} \quad y_D - y_A \; + \; k \frac{U_{j-\,k-} - U_{j-\,k}}{x_j - x_{j-}} \; y_D - y_A$$

$$- \quad k \; V_{j-\,k} + V_{j\,k} \; =$$

$$\frac{d}{dx} A V_{j\,k} + \quad V_{j\,k-} + V_{j\,k} \quad x_B - x_A \; + \quad p_{j\,k-} - p_{j\,k} \quad x_B - x_A$$

$$+ \; k \frac{V_{j\,k-} - V_{j\,k}}{y_k - y_{k-}} \; x_B - x_A \; - \quad k \; U_{j\,k-} + U_{j\,k} \; + \quad V_{j+\,k} + V_{j\,k} \quad U_{j+\,k} + U_{j\,k}$$

$$+ \; y_c - y_B \; - k \frac{V_{j+\,k} - V_{j\,k}}{x_{j+} - x_j} \; y_c - y_B \; - \quad k \; V_{j+\,k} + V_{j\,k} \; + \quad V_{j\,k+} + V_{j\,k} \quad x_C - x_D$$

$$+ \quad p_{j\,k+} + p_{j\,k} \quad x_C - x_D \; + \; k \frac{V_{j-\,k+} - V_{j-\,k}}{y_{k+} - y_k} \; x_C - x_D \; - \quad k \; U_{j\,k+} + U_{j\,k}$$

$$+ \quad V_{j-\,k} + V_{j\,k} \quad U_{j-\,k} + U_{j\,k} \quad y_D - y_A \; + k \frac{V_{j-} - V_{j\,k}}{x_j - x_{j-}} \; y_D - y_A$$

$$- \quad k \; U_{j-\,k} + U_{j\,k} \; =$$

$$\frac{U_{j+\,k} - U_{j-\,k}}{\Delta x} + \frac{V_{j\,k+} - V_{j\,k-}}{\Delta y} =$$

$$\mathbf{b}U + \mathbf{n}V + \mathbf{m}\,p = \mathbf{G}$$

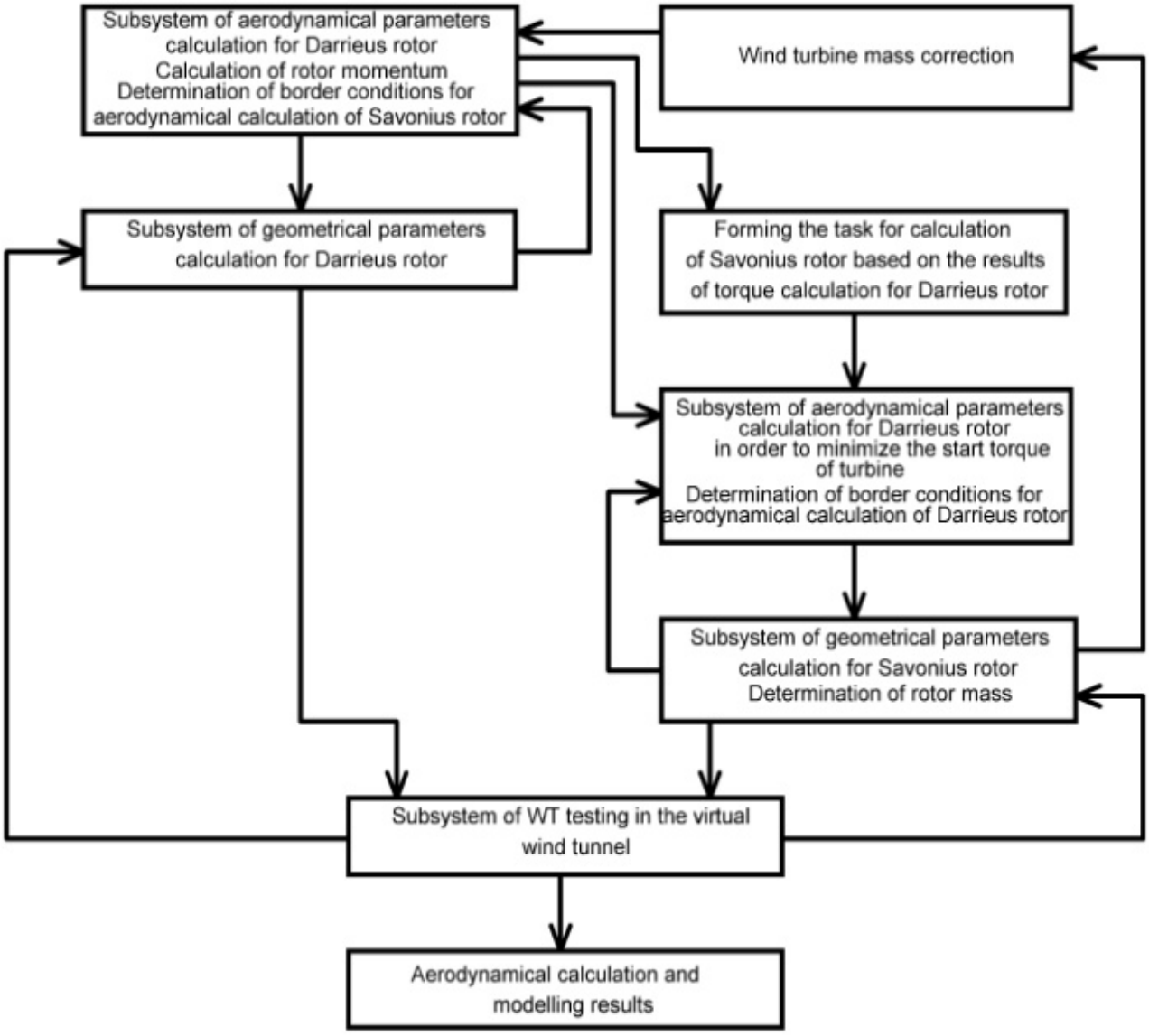
b,n,m
U, V, p **G**

$C_y \quad f$ $C_x \quad f$

U, V
p

y *V*

x *V*



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June 19

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В. М. Синєглазов, А. А. Зіганшин, М. П. Василенко. Алгоритм розрахунку аеродинаміки комбінованого ротора вітроенергетичної установки

Ключові слова:

Синєглазов Віктор Михайлович.

Зіганшин Анвар Абдуллович.

Василенко Микола Павлович

В. М. Синеглазов, А. А. Зиганшин, Н. П. Василенко. Алгоритм расчета аэродинамики комбинированного ротора ветроэнергетической установки

Ключевые слова

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