INTRODUCTION

With the development of the power transmission system, the occurrence of galloping is an important issue in the design of overhead transmission lines. The occurrence of galloping can lead to serious consequences such as system instability, equipment damage, and even loss of lifeline services.

BASIC MECHANISM

Galloping is a phenomenon that occurs when the wind force acting on a conductor causes it to oscillate. The oscillations can be large enough to cause the conductor to collide with surrounding objects, resulting in damage to the line and equipment.

The dynamics of galloping can be described by the following equation:

\[ M_y \ddot{y} + K_y y = F_{wind} \]

where \( M_y \) is the equivalent mass of the conductor, \( K_y \) is the equivalent stiffness of the conductor, \( y \) is the displacement of the conductor, and \( F_{wind} \) is the wind force acting on the conductor.

The wind force acting on a conductor can be expressed as:

\[ F_{wind} = C_D V^2 \frac{1}{2} \rho A \]

where \( C_D \) is the drag coefficient, \( V \) is the wind speed, \( \rho \) is the density of air, and \( A \) is the cross-sectional area of the conductor.

According to the theory of dynamics, the lift force \( F_L \) is given by:

\[ F_L = \frac{1}{2} \rho V^2 C_L \frac{A}{S} \]

where \( C_L \) is the lift coefficient and \( S \) is the reference area.

The lift force acting on a conductor can cause it to oscillate, resulting in galloping. The oscillations can be large enough to cause the conductor to collide with surrounding objects, resulting in damage to the line and equipment.

CONCLUSION

Galloping is a complex phenomenon that requires a detailed understanding of the dynamics of the conductor and the wind environment. By understanding the basic mechanism of galloping, engineers can design overhead transmission lines that are less susceptible to galloping, ensuring the safety and reliability of the power transmission system.
Modeling and control of the human locomotion system are essential for understanding and improving human movement. The human locomotion system is a complex dynamical system that involves multiple interacting components, including neural control, muscular activation, and joint mechanics. This system is responsible for generating stable and efficient movements that allow individuals to navigate their environment effectively.

The human locomotion system is typically modeled as a combination of a multi-link robotic system and a central nervous system (CNS) that generates control signals. The CNS consists of the brain, spinal cord, and peripheral nerves, which coordinate the movement of muscles and joints to achieve desired postures and motions.

In this model, the human locomotion system is represented as a series of interconnected segments, each with its own mass, inertia, and spring-damper parameters. The CNS generates control signals in the form of muscle activations, which are converted into joint torques by the musculoskeletal system. These torques are then applied to the segments, causing them to move and change their configuration over time.

The model includes equations of motion for each segment, which describe the relationship between the applied torques and the resulting angular accelerations and velocities. These equations are typically solved using numerical methods, such as the Runge-Kutta method, to simulate the movement of the system over time.

The control signals generated by the CNS are critical for the successful execution of movements. They are adjusted based on feedback from sensory inputs, such as joint angles and velocities, and are also influenced by higher-level cognitive processes, such as planning and intention.

The human locomotion system is subject to various constraints, such as joint limits and muscle forces, which limit the range of motion and the magnitude of forces that can be applied to the segments. These constraints are incorporated into the model to ensure that the simulated movements are physically plausible.

The model of the human locomotion system is an important tool for understanding human movement and for designing assistive technologies, such as exoskeletons and prostheses. It can also be used to study the effects of disease and injury on movement and to develop strategies for rehabilitation.

In the context of the model presented, the equations of motion for the robotic system are given by:

\[ \ddot{\theta}_i = \frac{\tau_i}{I_i} \]

where \( \theta_i \) is the angle of the \( i \)-th joint, \( \tau_i \) is the applied torque, and \( I_i \) is the moment of inertia of the segment.

The control signals are generated by the CNS and are represented by the vector \( U \):

\[ U = [u_1, u_2, ..., u_n] \]

where \( u_i \) represents the control signal for the \( i \)-th joint. The control signals are typically generated by a neural network or other computational model.

The model also includes terms for sensory feedback, which can be modeled as a gain (\( k \)) on the error between the desired and actual joint angles:

\[ \tau_s = k (\theta_{des} - \theta) \]

where \( \theta_{des} \) is the desired joint angle, \( \theta \) is the actual joint angle, and \( k \) is the sensory feedback gain.

The model represents a simplification of the complex interactions and control mechanisms that are involved in human locomotion. However, it provides a useful framework for understanding the principles underlying movement and for developing tools and technologies to assist and enhance human function.
where \( C_{20}, C_{23}, \text{and } C_{25} \) are the first-order derivatives of aerodynamic coefficients with respect to lift and moment on \( \beta \) respectively. Therefore, the 2-DOF inviscid conductor system with each mode is obtained in matrix form by

\[
\begin{pmatrix}
\Delta F_1 \\
\Delta F_2 \\
\Delta M_1 \\
\Delta M_2
\end{pmatrix} = \begin{pmatrix}
\beta_1 \\
\beta_2 \\
\beta_3 \\
\beta_4
\end{pmatrix}
\]

where \( \beta_1, \beta_2, \beta_3, \text{and } \beta_4 \) are the first-order derivatives of aerodynamic coefficients with respect to lift and moment on \( \beta \) respectively. The modified aerodynamic coefficients are given by

\[
\begin{align*}
\beta_1 &= \frac{\partial}{\partial \beta} \left( C_{10} \cos \beta + C_{20} \sin \beta \right) \\
\beta_2 &= \frac{\partial}{\partial \beta} \left( C_{13} \cos \beta + C_{23} \sin \beta \right) \\
\beta_3 &= \frac{\partial}{\partial \beta} \left( C_{15} \cos \beta + C_{25} \sin \beta \right) \\
\beta_4 &= \frac{\partial}{\partial \beta} \left( C_{16} \cos \beta + C_{26} \sin \beta \right)
\end{align*}
\]

The reduced wind speed \( \psi \) is related to the reduced mass \( \phi \) by the following relationship:

\[
\psi = \frac{1}{2} \phi \sin \psi \frac{2}{K_{20}} \sin \psi
\]

where \( K_{20} \) is the subconductor separation, \( f_s \) is the vertical frequency of lift and moment on \( \beta \). The other basic parameters are defined as follows:

- Reduced wind speed \( \psi \)
- Reduced mass \( \phi \)
- Reduced lift \( \beta_1 \)
- Reduced moment \( \beta_2 \)
- Cable span \( L \)
- Reduced mass density \( \rho \)
- Reduced density \( \rho_0 \)

By observing the effects of wind on a conductor, it is found that the wind speed decreases with the height of the conductor. This is due to the effects of the wind on the conductor's mass and the effects of the wind on the conductor's density. The reduced wind speed can be obtained from experimental observations as follows:

\[
\psi = \frac{\beta_1}{\phi_0} = \frac{\beta_2}{\phi_0}
\]

Some simulations

Case 1

The basic important parameters of transmission lines are type of cable, main conductor diameter, bundle geometry, bundle orientation, etc. In order to discover the most important physical parameters which influence galloping, a specific parameter analysis should be done. The best way to define galloping parameters is to be able to write down the basic parameter of the system, which are the most important parameters which influence the galloping of the system. This can be done by taking into account the fact that the cable conductor's mass is a function of the cable's mass and the cable's density. In order to define the basic parameters, the parameters which have no significant physical meaning will be neglected. The basic parameters which have significant physical meaning are as follows:

- Main conductor separation
- Main conductor diameter
- Main conductor density
- Main conductor mass density
- Main conductor's modulus of elasticity
- Main conductor's Young's modulus

Based on some analysis from the literature [12] about single-cable substation in this span.