

Notation

A : area

c : damping coefficient of bearing

$\mathbf{C}$: damping matrix

$\mathbf{f}_{crk}(t)$: vector of nonlinear crack forces

$\mathbf{f}_{gra}(t)$: vector of gravity forces

$\bar{\mathbf{F}}_{crk}$: vectors of harmonic coefficients of crack forces

$\tilde{\mathbf{F}}_{gra}$: vectors of harmonic coefficients of gravity forces

k : stiffness coefficient of bearing

k_a : area penalty coefficient

k_b : number of constraint modes

k_m : number of kept normal modes

$\mathbf{K}$: stiffness matrix

$\mathbf{K}_t$: tangent stiffness matrix

$\mathbf{M}$: mass matrix

N : number of nodes

$\mathbf{p}_{k_m}$: modal coordinates

$\mathbf{q}$: general coordinates

$\mathbf{Q}$: vectors of harmonic coefficients of displacements

$\tilde{\mathbf{R}}(\mathbf{Q})$: residual vector

$\mathbf{T}$: rotational matrix

$\mathbf{u}$: vector of nodal

$\tilde{\mathbf{Z}}(\Omega)$: dynamic stiffness matrix

$\Delta \mathbf{U}$: increments of displacements

$\Delta \Omega$: increments of rotational speed

θ : rotating angle

Φ : Transformation matrix of fixed-interface CMS

Φ_c : constrained modes matrix

Φ_m : kept normal modes matrix

Ω : rotational speed

Ω_{cr} : first critical rotational speed

Subscripts

crk: crack

gra: gravity

loc: local

i: internal DOFs

b: boundary DOFs

l: left part

r: right part

g: gap

m: kept normal modes

Superscripts

T: transpose

r: rotor

b: bearing

R: rotating frame

S: stationary frame

v: number of iteration