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Research of alloy Orb on wavelet

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Abstract. via completely after heat-treatment, [111] orientation of single crystal alloy structure is still cubic γ′ phase at way coherency are ordered in matrix g panel and the < 100 > direction rules arrangement; In high temperature and tensile stress creep period, with stress axes ordered γ′ has formed certain Angle raft shape organization, creep later in nearly fracture zone, raft shape γ′ ordered caring and distortion in happen, with strain increases, coarsening and distorted aggravating, until the present wavy shape; During the creep [111] orientation of single crystal alloys deformation characteristics is a wrong in γ′ matrix channel to sports and shear raft shape γ phase, due to form larger, more variable dislocation cut ordered after raft shape γ′, occurred in dislocation bunch of sets and its formation and crystal structure; Among them, the matrix channel to inherit the maximum shear dislocation slip is made of alloy with larger strain rate main reason.

Introduction

Crystal superalloys have been widely used as turbine blades for the good mechanical properties at high temperature. Since there are no grain boundaries, the nickel-base single crystal superalloys eliminate the void-damages localized at grain boundaries. This makes the nickel-base single crystal superalloy have better high temperature mechanic properties compared to the polycrystalline alloys. Differently to those polycrystalline alloys used in general structures, such as steel, SC superalloys behave as serious crystallographic orientation dependence [1]. However, at times there will be some defects, such as: holes, cracks and inclusions in casting alloy. Because of the defects, stress concentration reduces the alloy creep life. Research of the stress distribution near the roles and microstructure observation become very important. In this work an optimization strategy is presented where the structure modeled with the finite element method. The FEM model describes the structural dynamics of roles. In order to reduce computational effort, model reduction techniques are applied.

Wavelet transform

Generally there are two classes of wavelet transforms: the Continuous Wavelet Transform (CWT) and the Discrete Wavelet Transform (DWT).

Continuous Wavelet Transform (CWT)

The continuous wavelet transform (CWT) provides a method for displaying and analyzing characteristics of signals that are dependent on time and scale. It therefore is potentially a useful tool for detecting and identifying signals with exotic spectral features, transient information content, or other no stationary properties. The CWT is an operator that takes a signal and produces a function

of two variables: time and scale. As a two-variable function, it can be considered as a surface or image. The idea to be explored in this article is that features in this CWT surface result from parameters of the signal that could prove useful for its detection, characterization, classification, or conditioning. As a first step toward a process of signal characterization, we review the definition of the CWT and why this definition would have any relationship to the time varying scale and frequency structure of a signal. A particular wavelet well-suited to qualitative analysis of time series is the Morlet wavelet. An analysis of this wavelet is presented and its basic properties are described. Analytic calculations of the Morlet-based CWT on fundamental signals such as sinusoids, impulses, and linear frequency modulation are then derived, and the resulting CWT surfaces are shown and discussed. Finally, a set of no stationary and wideband signals is presented for which the CWT is an especially good tool for analysis and for the design of signal processing algorithms. These signals are of special interest in advanced communications and radar systems and indicate a particular advantage to considering the CWT as part of a signal intelligence toolkit. A particular empirical example of the use of the CWT for qualitative investigation of signal characteristics is also presented. In this example, a sampled time series of an underground explosion intended to emulate a seismic event is used as input to a CWT surface-generation algorithm. This time series is a good example of a transient waveform with certain additional characteristics. The CWT surface has features that can apparently be attributed to the shock and aftershock features in the event, and these features are not readily apparent for the time series or a spectral estimation from the time series. [2]

Wavelet is a function Ψ (x) obtained by stretching and translation of a set of functions:

$$\psi_{a,b}(x) = |a|^{-1/2}\psi\left(\frac{x-b}{a}\right) \quad a,b \in R, a \neq 0 \tag{1}$$

Ψ (x) is called basic wavelet or mother wavelet, which satisfy the compatibility conditions:

$$W_h = \int_{-\infty}^{\infty} \frac{|\psi(\omega)|^2}{|\omega|} d\omega < \infty \tag{2}$$

Wavelet transform as follows [3]:

$$L=L(\Psi(x), W_h) \tag{3}$$

Discrete Wavelet Transform (DWT)

The DWT is attractive primarily because the Mallet algorithm is a computationally efficient implementation of the WT and, depending on the mother wavelets used it is an (bi-) orthogonal transform. In particular, the DWT provides a sparse time-frequency representation of the original signal (the wavelet coefficients) that has the same number of samples as the original signal. Whilst an (bi-) orthogonal transform has been shown to be important for applications such as data compression and fast calculations, such importance has not been shown for multi-resolution analysis. [4]

The use of the continuous wavelet transform has gained increasing importance in many fields in analyzing the texture of matter distributions. However, the machinery we will develop here to estimate the power spectrum is based on the discrete wavelet transform. Unlike the case with the Fourier transform, in which the discrete Fourier transform is just the continuous Fourier transform estimated from a discrete grid of points, the difference between the CWT and DWT is more fundamental. The DWT is not constructed by estimating the CWT at discrete points. That is, one does not merely replace the integral with a sum and a continuous variable with a discrete variable. Generally, the basis functions of the CWT are over complete and no orthogonal, whereas the DWT basis functions are complete and orthogonal. Using the CWT can lead to correlations that are not in the sample, but due to the correlations among the wavelet coefficients. The DWT allows for an orthogonal projection on a complete set of modes and thus, the wavelet coefficients are independent [5].

Discrete wavelet transform as follows [6]:

$$a_0[n] = \int_{-\infty}^{\infty} f(t)\phi(t-n)dt \tag{4}$$

Finite element method (fem) simulation

The finite element method (FEM) is a numerical technique for finding approximate solutions of partial differential equations (PDE) as well as of integral equations. The solution approach is based either on eliminating the differential equation completely , or rendering the PDE into an approximating system of ordinary differential equations, which are then numerically integrated using standard techniques such as Euler's method, Runge-Kutta, etc [7]. In solving partial differential equations, the primary challenge is to create an equation that approximates the equation to be studied, but is numerically stable, meaning that errors in the input data and intermediate calculations do not accumulate and cause the resulting output to be meaningless .

When discussing the finite element methods we will, for notational simplicity, consider the case when simplicita meshes are used, but we emphasize already now that the big advantage of the Stabilized methods is that a very big freedom can be allowed in choosing the finite element spaces since no stability conditions are needed. Let now Rh be a partitioning of the whole of Rd into closed semplice (i.e. triangles and tetrahedrons, respectively) and assume that the partitioning satisfies the usual requirements that the intersection of two semplice is empty, a vertex, an edge or a face. The partitioning of is now defined as [7]

$$\zeta_h \{K | K = S \cap \Omega\} \tag{5}$$

The finite element subspace for the field variable is then defined as

$$V_h = \{v \in H^1(\Omega) | v_k \in P_k(k) \in \xi_h\} \tag{6}$$

where Pk(K) denotes the polynomials of degree k 1 on K.

Two-dimensional finite element theory equations in general as follows:

$$\frac{\partial}{\partial x}\left[\alpha_x \frac{\partial \Phi(x,y)}{\partial x}\right] + \frac{\partial}{\partial y}\left[\alpha_y \frac{\partial \Phi(x,y)}{\partial y}\right] + \beta\Phi(x,y) = f(x,y) \tag{7}$$

α_x, α_y and β are known parameters, and they are x, y function. Because of the finite element nodes of each unit must have two degrees of freedom to express coordinates in each direction of displacement; it is a vector, both the direction and size. Then the metal creep strain equation of the displacement theory that Hooker's law is as follows:

$$\frac{\partial \sigma_{xx}}{\partial x} + \frac{\partial \sigma_{xy}}{\partial y} + f_x = 0 \tag{8}$$

$$\frac{\partial \sigma_{xy}}{\partial x} + \frac{\partial \sigma_{yy}}{\partial y} + f_y = 0 \tag{9}$$

It said that each stress component with each component on the strain. With engineering constants, Young's modulus and Poisson's ratio, the use of Cartesian coordinates can be calculated plot of stress, strain and displacement.

Simulation results

Along the figure 1 (a) a′, b′ dashed intercepted profile, get γ/γ′ two-phase in (100) von Mises two-dimensional crystal stress distribution, as shown in figure 1 von Mises phase γ′ of the stress distribution 1(a) as shown, can see, and vertical interface, compared to nearly a′ point area in nearly b′ level interface von Mises regional have high stress, value the value for 172 MPa. Figure 1 (b) for γ matrix channel Mises equivalent stress distribution von contour lines, it can be seen in (001) and (010) the crystal with maximal intersect with the von Mises stress level, comparison, vertical

channel matrix channel has great von Mises stress, its value, as shown in figure about 453 MPa 5.9 (b) shown isoline G, while in nearly b area (namely the point for figure 1 a and b point) of the stress value for 386 MPa. Show that in γ and γ′ two-phase different faces has different von Mises stress distribution, strain energy density change also has similar distribution, the bigger the von Mises stress produce larger main stress components ($\bar{\sigma}$ ij). From γ , γ′ two phase of a, b and a′, b′ extract the decomposition of the principal stress in stress is shown in figure weight 1 respectively (a) and (b).

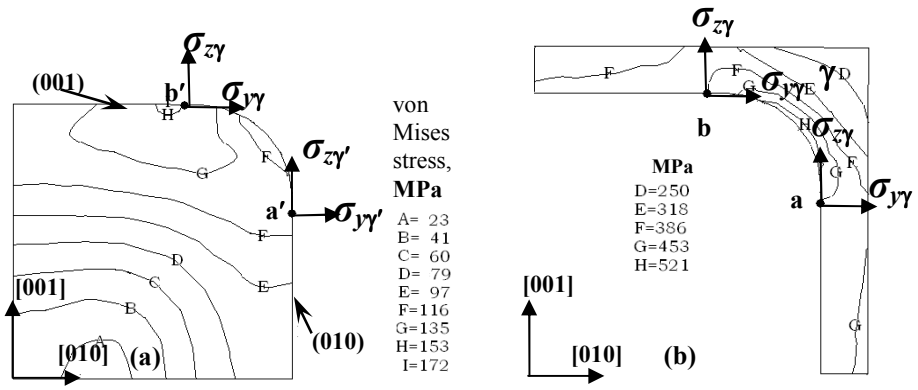

Figure 1. Distribution maps of von Mises stresses

Conclusion

In high temperature under the action of tensile stress, cubic γ' phase different faces happen different strain energy density change, among them, γ' down strain energy larger faces directional growth, but between atoms potential, interface and the lattice mismatch is to make the change of stress diffusion and γ' phase happened element driving force of directional coarsening.

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