Detailed instruction for testing of ViscoFit

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Installation

ViscoFit MATLAB-based app: double click the document 'ViscoFit.exe' to install then run it.

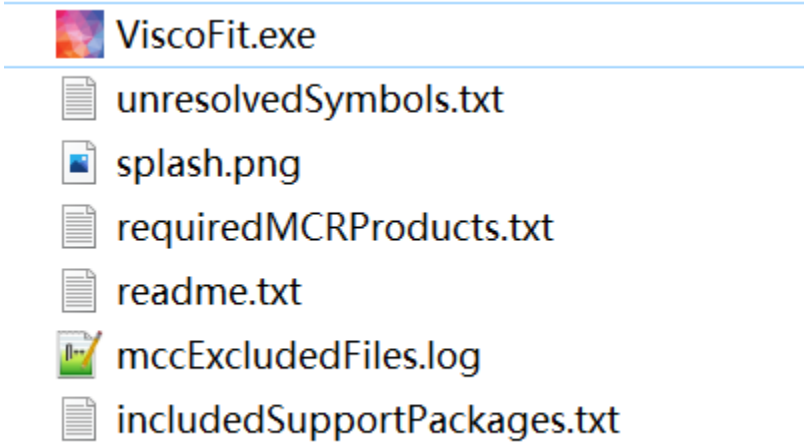

Fig. 1 The installation of ViscoFit

General information

Viscofit is a software tool specifically designed to fit the parameters of fractional creep and relaxation models. It offers two modules: Creep Parameter Fitting and Relaxation Parameter Fitting, aiming to provide highly precise and accurate parameter fitting results.

The Creep Parameter Fitting module allows users to input relevant experimental data

and utilizes the Powell algorithm for fitting the parameters of the fractional creep model. This module enables researchers and engineers to accurately predict the creep behavior of materials, gain a better understanding of their time dependence, and provide valuable insights for design and engineering applications.

Similarly, the Relaxation Parameter Fitting module, also based on the Powell algorithm, fits the parameters of the fractional relaxation model by inputting relevant experimental data. This module enables users to more accurately predict the relaxation behavior of materials and obtain reliable results for material performance evaluation and reliability analysis.

The primary goal of Viscofit is to provide researchers and engineers with an efficient and precise tool for analyzing and simulating the behavior of fractional-order viscoelastic materials. By using Viscofit, users can save time and effort, achieve more accurate parameter fitting results, and make informed decisions in areas such as material design, performance evaluation, and reliability analysis.

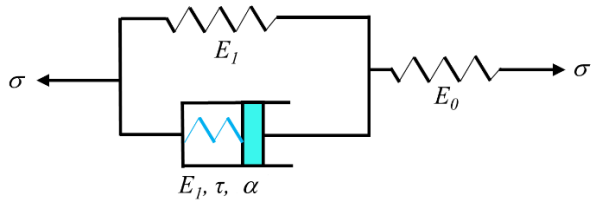

Fig. 2 Fractional Calculus-based FPT Model

The creep compliance is

$$J(t)=\frac{1}{E_0}+\frac{1}{E_1}\left[1-E_{\alpha,1}\left(-\left(\frac{t}{\tau}\right)^{\alpha}\right)\right] \tag{1}$$

The relaxation modulus is

$$R(t)=\frac{1}{\frac{1}{E_0}+\frac{1}{E_1}\frac{1}{1+\frac{1}{\Gamma(1-\alpha)}\left(\frac{t}{\tau}\right)^{-\alpha}}} \tag{2}$$

Where E_0, E_1, τ, α are obtained by fitting the test results.

Layout of ViscoFit

• There are three tabs which are ViscoFit (main part), Instruction and Help in the ViscoFit app.

Fig. 3 The three tabs in ViscoFit app

• The ViscoFit tab is the main part for the ViscoFit app, the Instruction tab contains a brief operation manual, and the Help tab is to provide further help to the users.

• As showed in Figure 3, there are four main parts: 1. Import data and check its validation, 2. Initial parameter setting, 3. Results display and 4. Brief tutorial.

• Import data: to load the measured creep or relaxation data from Excel (.xlsx format) document.

• Initial parameter setting: to set the initial value of the parameter.

• Results display: to display the comparison between the measured (or given) value and the predicted value based on fractional calculus model, the equations of fractional calculus model, and the determined paramters.

• Brief tutorial: to briefly introduce the operation procedure and the functions of ViscoFit.

Steps

The steps are as follows:

Open the software interface, as shown in Fig. 4.

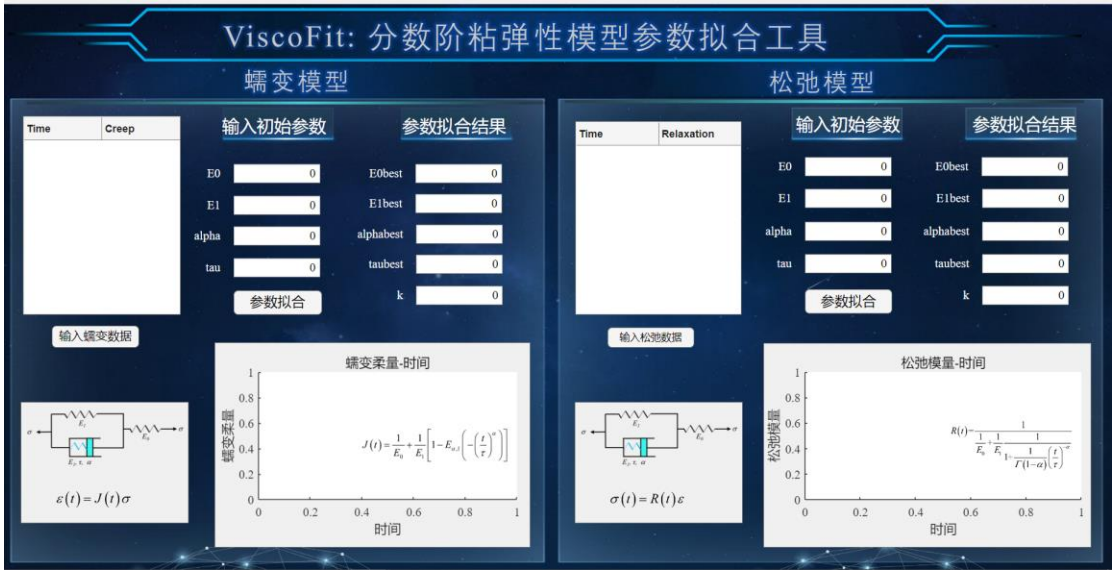

Fig. 4 The app interface of ViscoFit

Click "Import creep data" in the creep model on the left to import creep test data from an Excel file. Upon importing, the test data points will be displayed as blue dots on the creep compliance-time curve in the lower left corner, as shown in Fig. 5. Additionally, the schematic diagram and formula of the fractional viscoelastic model will be visible in the same corner. The software will automatically calculate the initial values of the parameters based on the input test data. However, the user has the flexibility to modify these initial values according to their specific requirements.

To perform parameter fitting, click on the "Parameter fitting" option as depicted in Figure 4. The software will employ the Powell algorithm for fitting and provide the exact values of the parameters. The number of iterations performed during the fitting process will be displayed as "k." The resulting fitted curve will appear as a red line in the figure.

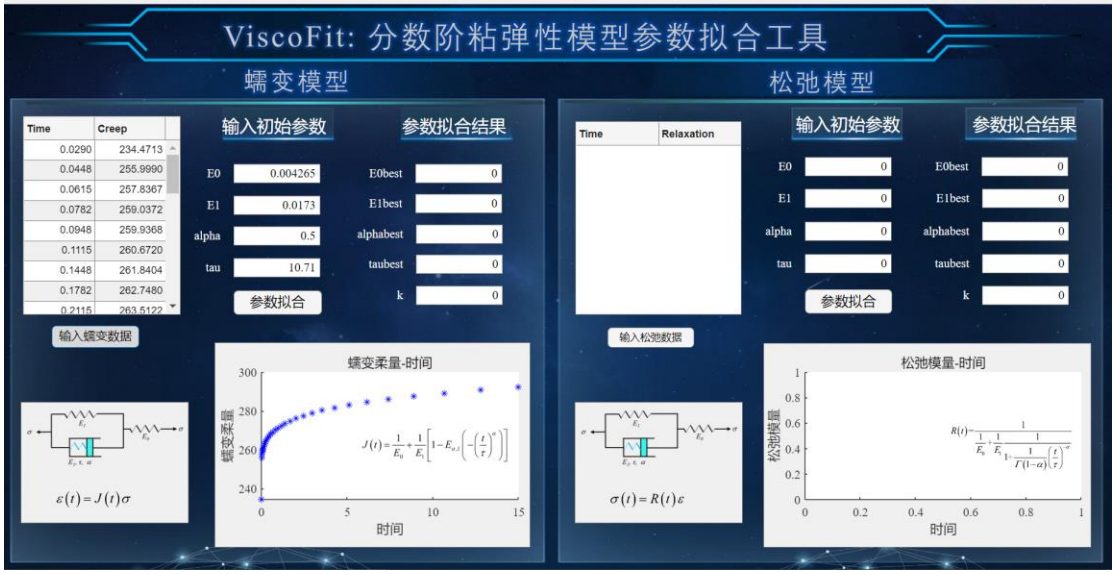

Fig. 5 Import creep test data

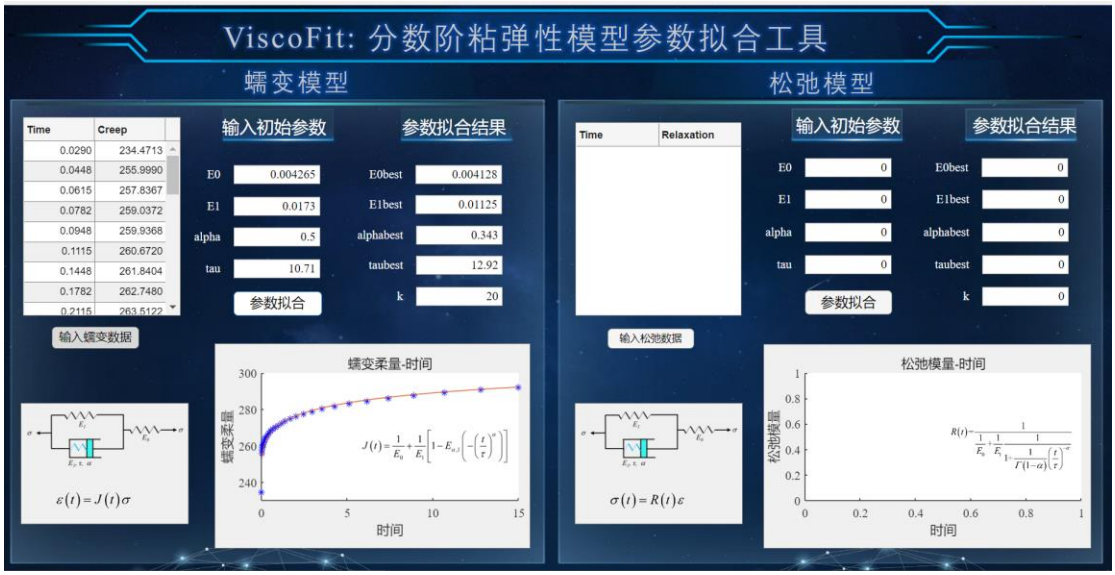

Fig. 6 Creep model parameters obtained by fitting algorithm

Click "Import relaxation data" in the relaxation model on the left to import relaxation test data from an Excel file. Upon importing, the test data points will be displayed as blue dots on the relaxation modulus-time curve in the lower right corner, as shown in Fig. 7. Additionally, the schematic diagram and formula of the fractional viscoelastic model will be visible in the same corner. The software will automatically calculate the initial values of the parameters based on the input test data. However, the user has the flexibility to

modify these initial values according to their specific requirements.

To perform parameter fitting, click on the "Parameter fitting" option as depicted in Fig. 8. The software will employ the Powell algorithm for fitting and provide the exact values of the parameters. The number of iterations performed during the fitting process will be displayed as "k." The resulting fitted curve will appear as a red line in the figure.

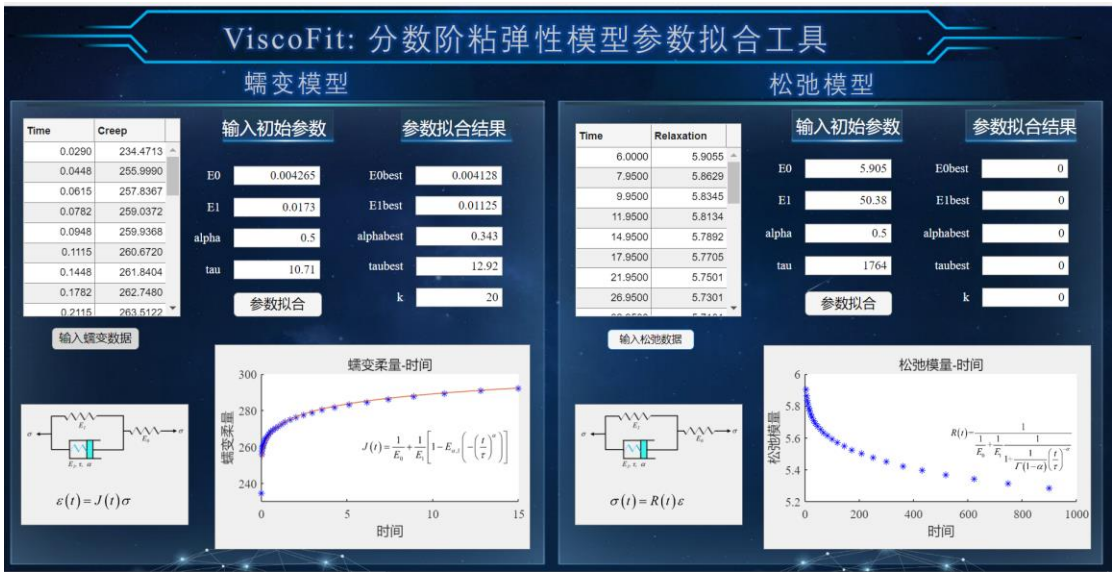

Fig. 7 Import relaxation test data

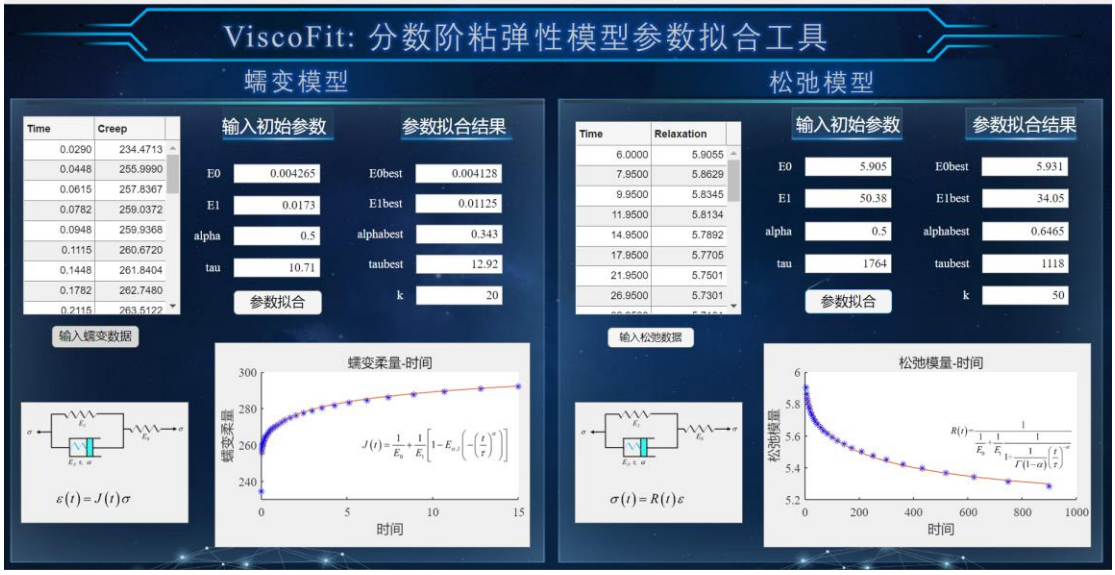

Fig. 8 Relaxation model parameters obtained by fitting algorithm