Comments on the manuscript:

Folding and necking across the scales: a review of theoretical and experimental results and their applications

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Comment Regarding LAF

The initial stages of fold development in the infinitesimal amplitude limit are well described by thin plate (if the viscosity ratio is high enough) and thick plate stability analysis (which is the exact solution). Both predict exponential growth of the amplitude with strain according to the respective growth rate spectra, which do not evolve in time. This model does not do a very good job in predicting large amplitude fold geometries with strain. There are two main processes that modify the exponential growth of single components.

1) As the layer folds it 'escapes' the applied far-field shortening, i.e. the actual layer (arc length) shortening rate is less than the shortening of the entire system. This leads to a slowdown of fold amplification as well as a structural softening of the system. This process was studied by Schmalholz and co-workers in a number of papers and is referred to as the finite amplitude solution (FAS).

2) The growth rate is a function of the wavelength to thickness ratio. The layer thickness increases due to the progressive shortening (at least as long as the individual limbs have not rotated too much) and wavelength decreases. This means that the growth rate of a given component (initial wavelength to thickness ratio) must change if its wavelength and thickness evolve. The component that has initially the highest amplification rate will in the next moment not be the fastest component any longer. Instead a component with an initially larger wavelength to thickness ratio will have the largest integrated amplification. This process is referred to as preferred wavelength development and was originally discussed in Sherwin and Chapple and then by Fletcher and Sherwin.

In LAF, we combine the thick plate stability analysis with both of these processes. We introduce various improvements and obtain a conceptually simple model that is capable of predicting fold development up to large amplitudes. The importance of LAF does not so much lie in the details of thick versus thin plate or how the elliptical integrals of the arc length evolution are approximated – its importance is that it combines all the key processes.

Line 453-onwards

A rather unfortunate way to introduce LAF. It is discredited before it is properly introduced in the next paragraph. We disagree with the statement that LAF developed for multiple waveforms does not represent a great improvement compared to the single waveform solution. Below we show a modified version of Fig. 16 illustrating the results of the fold shape evolution for the numerical (FEM, grey fold), LAF for single (blue), and LAF for multiple (red) wavelength solution.

LAF derived for single waveforms should not be used in multiple waveform cases. After 25% of shortening, LAF for multiple waveform and single waveform differ significantly. At 25% shortening the multiple waveform solution still fits the FEM model well. The limb dip at this stage is ~ 45º. In our opinion this is a great improvement compared to the superimposed single sinusoidal solutions.

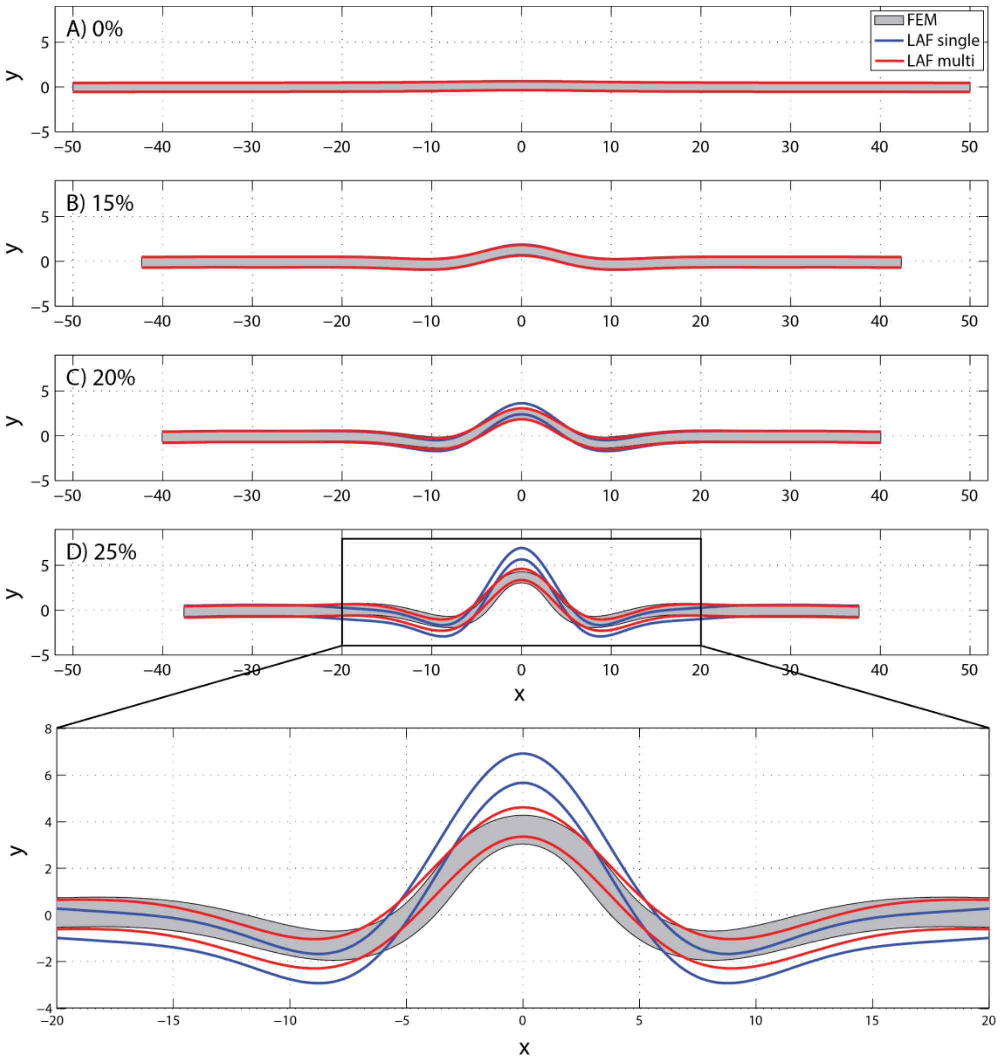

Fig. 1 Evolution of the fold geometry perturbed with a bell shape function shown for numerical results (grey layer) and derived analytically using LAF for single sinusoidal waveforms (blue) and multiple waveform (red) solutions. Top four figures show the evolution from 0 to 25% shortening. The bottom figure is a zoomed version of the final stage.

Detailed Comments

Line 410: it should be $ds/dt = -2\bar{D}_{xx}s$. s0 is incorrect in this context.

Line 415 - onwards: This paragraph is misleading. Here, a new equation should be presented that introduces the correction to Eq. 16. Otherwise the correction $\bar{D}_{xx}$ applies to both passive and dynamic amplification. Why not to show the expression for the correction?

When the authors refer to finite amplitude solution they should specify which one (i.e. which version of FAS, LAF, ?). In Schmalholz (2006), there are two expressions for the growth rate correction provided, i.e. Eq. 18 and 19. The second expression is a slight modification of Eq. 18 that is claimed to only differ by 10%. However, the difference in the growth rate spectrum is large. We show this with a modified version of Fig. 13b (from the paper submitted by Schmalholz and Mancktelow), where different analytical solutions are provided for a linear viscous material and large initial amplitude $A_0/H=0.2$ (Fig. 2A). This large initial amplitude is the reason for the mismatch between thick plate and numerical (FEM) growth rates. The two versions of FAS correct the thin plate prediction, on which they are based, towards lower growth rates. One correction (Eq. 19, green line) essentially matches the thick plate solution while the other one (Eq. 18, blue line) yields lower values. Only LAF produces a perfect match of the numerically computed growth rate spectrum.

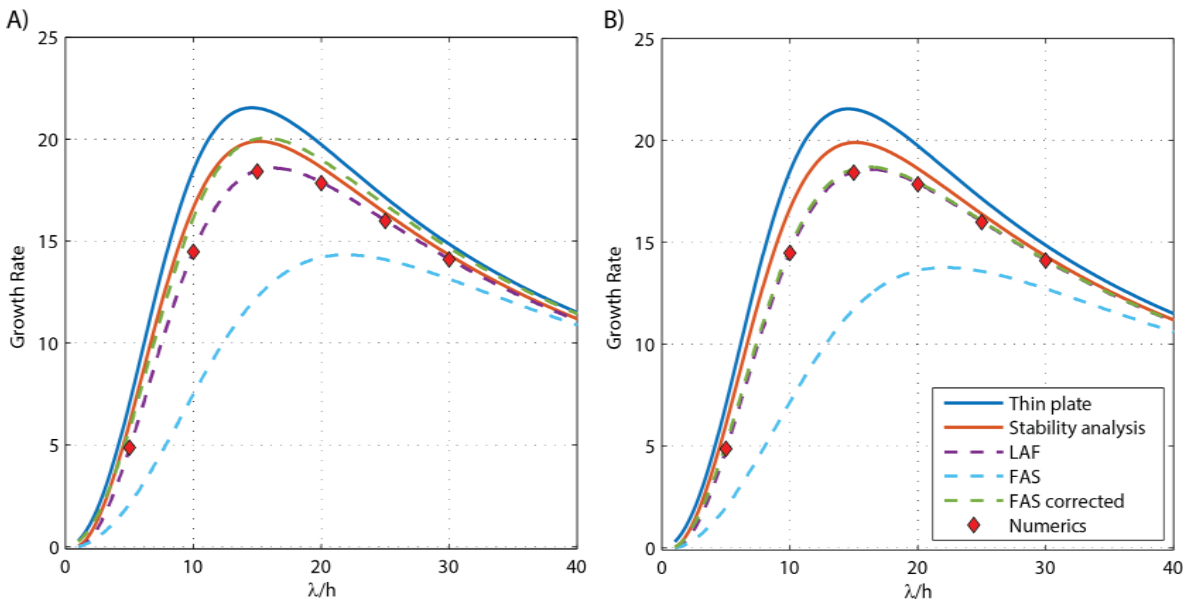

Fig. 2 Growth rate solutions for different theoretical models (refers to the Fig. 13b). We use in A) thin plate and in B) thick plate solution in the FAS model.

The question arises how FAS would perform if it would be based on thick plate. This is shown in Fig. 2b. The green dashed curve (FAS, Eq. 19) essentially coincides with the numerical and the LAF results. The remaining minor differences are due to the different ways of evaluating the elliptical integral of the arc length evolution. In LAF we solve the actual set of equations while in

FAS several (cascading) simplifications are made. Which approach is better is a moot point. Elliptic integrals are special but such are sine and other functions.

Fig. 2 shows that both FAS and LAF do a good job predicting the growth rate for this static case of relatively large initial amplitude. But only LAF considers how the wavelength and thickness of individual components evolve with strain and therefore does a better job reproducing the finite amplitude evolution.

Line 440: The exact solution has been presented by Adamuszek et al. 2013.

Line 504: Shouldn't be "-" here? Writing equal sign here can be also misleading. Write ($-D_{xx}t \approx 0.2$)

Line 1540: What is k? For consistency, it would be better to use s.