Title:

On the optimum shape for fatigue crack initiation specimens

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Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

Fatigue test specimens have notches that connect their uniform test section to the larger heads required to grip them. Since such notches locally concentrate the nominal stress around their roots, they may localize the crack initiation point, spoiling the test results, or at least increasing their dispersion.

Engineers like to specify notches with as large as possible constant radius roots, since they can be easily fabricated in traditional machine tools. However, notches with properly specified variable radii can have much lower stress concentration factors than those obtainable by fixed notch root radii. In fact, natural structural members, such as tree branches and bones, evolved learning to use variable radii instead of the fixed radius typical of engineering notches. Such improved notches are a very good design option to augment fatigue lives without significantly affecting structural components global dimensions and weight. Moreover, they are certainly more useful than ever, since nowadays they can be economically specified and manufactured due to the wide availability of computer numerically controlled machine tools.

Since constant radius notch shapes do not minimize stress concentration effects in fatigue specimens, they certainly are not the best choice to build them. This problem has been recognized for a long time, but variable radii notches optimized to minimize their deleterious influence on fatigue strength still are not widely used in mechanical design, neither even in the normalized specimens used to measure crack initiation properties.

The objective of this paper is to quantify the stress concentration improvements achievable by optimizing variable radii notches for cylindrical and flat fatigue test specimens used in push-pull, rotary bending, alternated bending, and for tubular specimens used in multiaxial load tests. Such improved specimen profiles are then described by analytical functions that can be easily used for manufacturing them in any CNC machine.