Optimization of contact pressure using super-ellipse profile

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ABSTRACT

In many rolling or sliding contact mechanisms, like roller bearings, journal bearings, gearings or any contact between two semi-infinite bodies, concentrated stress occurs at the edges of the contact. This stress, due to what is called edge effects, is known to be very fatigue damaging. To avoid this concentrated stress, in common roller bearings, the rolling surface of the roller and/or of the rack is crowned. The crowning shapes usually include a straight line and one or a combination of circular arcs. Even if those crowning profiles are efficient to avoid edge effects, they are far from an optimized shape in terms of contact pressure distribution. In recent years, a shape of crowning based on a logarithmic function developed by Lundberg has been improved and optimized for the purpose of industrialization. However, these profile are quite complex and they have only been developed for roller bearings and not for other types of rolling or sliding contacts.

This paper presents a new profile based on a super-ellipse equation. With this profile, it is really straightforward to set parameters, depending on the application involved. It can be adapted to all kinds of contact simply by changing the order of the super-ellipse profile. The benefits of the super-ellipse profile are an even contact pressure distribution, no edge effect, and a design still easy to manufacture.

Several concrete applications are presented, all of them concerning the VCRi engine developed by MCE-5 Development. This engine presents a wide range of contact mechanism of various shapes, either sliding (side-pusher contact, journal bearings) or rolling (synchronized roller contact), and even rolling and sliding (gear mesh contact).

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