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信息科学

鞋楦定制中非均匀有理B样条特征曲线的自适应变形

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摘要：　为实现无实体楦基础的数字化量足制鞋，提出了基于非均匀有理B样条(NURBS)特征曲线自适应变形的个性化鞋楦定制系统，将足部NURBS特征曲线依据一定的舒适度规则变形成相应的鞋楦特征曲线来实现鞋楦定制。该系统采用切平面法获取足部的特征点、特征曲线和特征尺寸，重建出足部NURBS特征曲线。建立了足楦舒适度匹配规则，并根据变形方式及次序不同将特征曲线分为四种类型。以特征点、特征结点和特征尺寸作为约束，结合足楦舒适度规律驱动足部特征曲线自适应变形，生成相应的鞋楦特征曲线。最后，构建出鞋楦特征框架，通过特征曲线增添操作和曲面细分造型完成定制鞋楦的设计。给出了男士皮鞋鞋楦的设计实例和定制结果，定制时间在480 s内，定制的鞋楦美观大方。该系统具有实用性，且定制鞋楦的再设计利用率显著提高。

关键词：　足部特征信息　非均匀有理B样条特征曲线　鞋楦定制　自适应变形　舒适度匹配规则

Adaptive deformation of characteristic NURBS curves for customized shoe-last

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Abstract: To make customized shoes without standard shoe-lasts, a customized shoe-last system is established based on the adaptive deformation of Non-uniform Rational B Spline (NURBS) curves for foot characteristics. The system uses the deformation from foot characteristic curves to make shoe-lasts based on comfortable matching rules. First, the cutting plane method is used to acquire the characteristic information, including characteristic points, characteristic curves and characteristic sizes, following that, the characteristic curves are reconstructed in NURBS. Then, the comfortable matching rules between feet and shoe-lasts are established, and characteristic curves are divided into four different types according to different deformation ways and orders. Furthermore, the foot characteristic curves are deformed to shoe-last's characteristic curves driven by the comfortable match rules in the constraints of the characteristic points, characteristic nodes and the characteristic sizes. Finally, it structures the shoe-last's characteristic frame, and finishes the design of customized shoe-last through adding characteristic curves and subdividing the surface mesh of shoe-last. With this system, a men's leather shoe with comfort and beauty can be customized in less than 480 s. This system is practical, and can increase greatly the utilization of redesign for customized shoe-lasts.

Keywords: foot characteristic information　characteristic NURBS curves　shoe-last customizing　adaptive deformation comfortable matching rule

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参考文献：

[1]万孝军. 基于逆向工程鞋楦参数化建模及其修改技术研究[D]. 合肥：合肥工业大学，2009. WAN X J. Research on parametric modeling of shoe-last and its modification based on reverse engineering [D]. Hefei: Hefei University of Technology, 2009. (in Chinese) [2]孙毅，丘理. 鞋楦设计教程[M]. 北京：中国轻工业出版社，2011. SUN Y, QIU L. The Course of Last Design [M]. Beijing：China Light Industry Press，2011. (in Chinese) [3]ROUT N, KHANDUAL A, ZHANG Y F, et al.. 3D foot scan to custom shoe last [J]. Special Issue of IJCCT, 2010, 1(2/3/4): 14-18. [4]XIONG SH P, ZHAO J H, JIANG Z H, et al.. A computer aided design system for foot-feature-based shoe last customization [J]. The International Journal of Advanced Manufacturing Technology, 2010, 46(1-4): 11-19. [5]徐从富，刘勇，蒋云良. 个性化鞋楦CAD系统的设计与实现[J]. 计算机辅助设计与图形学学报，2004，16(10)：1437-1441. XU C F, LIU Y, JIANG Y L. Design and realization of customized shoe last CAD system [J]. Journal of Computer Aided Design & Computer Graphics, 2004, 16(10): 1437-1441. (in Chinese) [6]陆国栋，顾铭秋，王剑，等. 基于脚部三维扫描的鞋楦建模方法研究[J]. 设计与研究，2005，32（4）：13-15. LU G D, GU M Q, WANG J, et al.. Research of shoe-last modeling algorithm based on feet range scans [J]. Design and Research, 2005, 32(4): 13-15. (in Chinese) [7]贾倩倩，王伯雄，罗秀芝. 光切法形貌测量中光条中心的亚像素提取 [D]. 光学 精密工程，2010，18（2）：390-396. JIA Q Q, WANG B X, LUO X Z. Extraction of central positions of light stripe in sub-pixel in 3D surface measurement based on light sectioning method [D]. Opt. Precision Eng., 2010, 18(2): 390-396. (in Chinese) [8]PIEGL L, TILLER W. The NURBS Book [M]. Berlin: Springer, 1995. [9]沈洪垚. 自适应NURBS曲线插补关键技术及实现研究[D]. 杭州：浙江大学，2010. SHEN H Y. Research on adaptive NURBS interpolation and implementation [D]. Hangzhou: Zhejiang