15-464 / 15-664 Reference List for Feb 6, 2017

Here is the paper we looked at last week, outlining variations on classic Jacobian techniques for inverse kinematics:

Buss, Samuel R. "Introduction to inverse kinematics with jacobian transpose, pseudoinverse and damped least squares methods." *IEEE Journal of Robotics and Automation* 17 (2004): 1-19.
http://web.cse.ohio-state.edu/~parent/classes/694A/Lectures/Material/IKsurvey.pdf

This paper expands on this approach a little bit, adding the notion of priorities and illustrating well the results of using this approach for character posing.

Yamane, Katsu, and Yoshihiko Nakamura. "Natural motion animation through constraining and deconstraining at will." *Visualization and Computer Graphics, IEEE Transactions on* 9, no. 3 (2003): 352-360.
http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1207443

The classic approach has been recently parallelized to work quickly for many degree of freedom characters on a modern GPU. This paper is also worth reading for one more description of the classic approach to IK.

Harish P, Mahmudi M, Callennec BL, Boulic R. Parallel inverse kinematics for multithreaded architectures. ACM Transactions on Graphics (TOG). 2016 May 25;35(2):19.
http://dl.acm.org/citation.cfm?id=2887740

However, in some applications, even faster results may be desired. For fast IK, CCD is the standby approach:

Lander, Jeff. "Oh My God, I Inverted Kine!." *Game Developer Magazine* 9 (1998): 9-14.
http://graphics.cs.cmu.edu/nsp/course/15464-s15/www/lectures/lec06/jlander_gamedev_sept98.pdf

Lander, Jeff. "Making kine more flexible." *Game Developer Magazine* 1, no. 15-22 (1998): 2.
http://graphics.cs.cmu.edu/nsp/course/15464-s15/www/lectures/lec06/jlander_gamedev_nov98.pdf

However, CCD can create artifacts such as the end effector curling in on itself. This approach is also very fast and in the same style, but seems to do better.

Aristidou, Andreas, and Joan Lasenby. "FABRIK: a fast, iterative solver for the inverse kinematics problem." *Graphical Models* 73, no. 5 (2011): 243-260.
http://www.andreasaristidou.com/FABRIK.html

This classic inverse kinematics paper points out that using iterative approaches where we think of finding an inverse kinematics solution as the result of a process is a little silly if we only want the final pose. Why not pose the problem as a more general optimization problem and let one of the vast library of solvers out there do the work of finding an answer?

Zhao, Jianmin, and Norman I. Badler. "Inverse kinematics positioning using nonlinear programming for highly articulated figures." *ACM Transactions on Graphics (TOG)* 13, no. 4 (1994): 313-336.
http://ai.stanford.edu/~latombe/cs99k/2000/badler.pdf

Another view of how to do inverse kinematics is to build a low dimensional space of poses based on keyframed or motion capture data. Then, inverse kinematics will restrict the solution space to this lower dimensional space of poses, hopefully resulting in more natural results. The next three papers illustrate techniques with this flavor. Note that the third technique, which we did not cover in class, handles multiple types of poses (from different activities) quite well.

Grochow, Keith, Steven L. Martin, Aaron Hertzmann, and Zoran Popović. "Style-based inverse kinematics." In *ACM Transactions on Graphics (TOG)*, vol. 23, no. 3, pp. 522-531. ACM, 2004.
http://grail.cs.washington.edu/projects/styleik/

Bailey SW, Watt M, O'Brien JF. Repurposing hand animation for interactive applications. InProceedings of the ACM SIGGRAPH/Eurographics Symposium on Computer Animation 2016 Jul 11 (pp. 97-106). Eurographics Association.
http://graphics.berkeley.edu/papers/Bailey-RHA-2016-07/

Choi MG, Lee KH. Points-based user interface for character posing. Computer Animation and Virtual Worlds. 2016 May 1;27(3-4):213-20.
http://myunggeol.com/projects/PointBasedPosing/PBK_CAVW_preprinted.pdf
https://www.youtube.com/watch?v=kkK1H4gkRJw&feature=youtu.be

This paper creates poses from silhouette drawings. You may check whether their software is available online to try out.

Bessmeltsev M, Vining N, Sheffer A. Gesture3D: posing 3D characters via gesture drawings. ACM Transactions on Graphics (TOG). 2016 Nov 11;35(6):165.
http://dl.acm.org/citation.cfm?id=2980240

This paper uses the leapmotion to aid in character posing:

Kyto M, Dhinakaran K, Martikainen A, Hamalainen P. Improving 3D Character Posing with a Gestural Interface. IEEE computer graphics and applications. 2015 Nov 11.
http://ieeexplore.ieee.org/abstract/document/7325194/

The next two papers consider the problem of inverse kinematics on meshes which have no skeleton. The first of the two is the classic paper. The second offers suggestions for improvements.

Sumner, Robert W., Matthias Zwicker, Craig Gotsman, and Jovan Popović. "Mesh-based inverse kinematics." In *ACM Transactions on Graphics (TOG)*, vol. 24, no. 3, pp. 488-495. ACM, 2005.
http://people.csail.mit.edu/sumner/research/meshik/

Wampler K. Fast and reliable example-based mesh IK for stylized deformations. ACM Transactions on Graphics (TOG). 2016 Nov 11;35(6):235.
http://dl.acm.org/citation.cfm?id=2982433

I mentioned this paper in class, which allows puppeteering non-humanlike characters using your entire body.

Seol Y, O'Sullivan C, Lee J. Creature features: online motion puppetry for non-human characters. InProceedings of the 12th ACM SIGGRAPH/Eurographics Symposium on Computer Animation 2013 Jul 19 (pp. 213-221). ACM.
http://dl.acm.org/citation.cfm?id=2485903