MidcurveNN: Encoder-Decoder Neural Network for Computing Midcurve of a Thin Polygon

machine-learning-&-deep-learning   Talk   45 Mins   Intermediate   midcurve   encoder-decoder   neural-network

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schedule Aug 9th 04:00 - 04:45 PM   place Grand Ball Room 2

Various applications need lower dimensional representation of shapes. Midcurve is one- dimensional(1D) representation of a two-dimensional (2D) planar shape. It is used in applications such as animation, shape matching, retrieval, finite element analysis, etc. Methods available to compute midcurves vary based on the type of the input shape (images, sketches, etc.) and processing approaches such as Thinning, Medial Axis Transform (MAT), Chordal Axis Transform (CAT), Straight Skeletons, etc., all of which are rule-based.

This presentation talks about a novel method called MidcurveNN which uses Encoder-Decoder neural network for computing midcurve from images of 2D thin polygons in supervised learning manner. This dimension reduction transformation from input 2D thin polygon image to output 1D midcurve image is learnt by the neural network, which can then be used to compute midcurve of an unseen 2D thin polygonal shape.

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Outline/Structure of the Talk

- Introduction
- Proposed Method
- Data acquisition, preparation
- Implementation
- Results
- Conclusion and future work

Learning Outcome

- How to treat geometric shapes as input data?
- Applicability of Deep Learning to model geometric Transformation.

Target Audience

Anyone familiar with basics of Deep Learning ,Students/ Professionals with college level Geometry

Slides

http://vixra.org/abs/1904.0429

Video

https://www.youtube.com/embed/TcPYEa410PI?feature=oembed

Links

- Research publications at Google Scholar:https://scholar.google.co.in/citations?user=RuELzwYAAAAJ&hl=en
- Details about workshops, training done elsewhere: http://www.yati.io

schedule Submitted 1 month ago

Public Feedback

comment SUGGEST IMPROVEMENTS TO THE SPEAKER

By Ashay Tamhane ~ 3 weeks ago

reply Reply

Hi Yogesh, thanks for proposal. Very interesting. Could you kindly elaborate on if you intend to compare the proposed algorithm with the rule based approaches in terms of the results? Also, some visual intuition on why midcurves work will be very interesting.

By Yogesh H. Kulkarni ~ 3 weeks ago

reply Reply

Thanks for the comments, Ashay.

Yes, I intend to compare the proposed Neural Networks approach with the currently established rule based approach.

As mentioned in the linked paper, for the proposed MidcurveNN technique, post processing would be needed, mainly for noise removal (stray, wrongly classified pixels) and vectorisation (converting image back to geometry). Once, done we should be able to have apple-to-apple comparision, meaning resultant geometries of

rule-based and MidcurveNN approaches. But as of now, some form of comparison can be put in place to demonstrate the efficacy of the technique.

Applications of midcurve have been mentioned in the comment below (to Dr Vikas's query) and more can be seen at http://www.inf.u-szeged.hu/ssip/2008/presentations/Palagyi_Skeleton_ssip2008.pdf.

The proposed technique, MidcurveNN, is still at an early stage compared to the rule based approaches, which are about 60-70 years mature. But the results of MidcurveNN clearly demonstrate its ability to learn the dimension-reduction function on its own. That's promising. But still a long way to go for it to become production-ready.

The intent of the talk is for the awareness and to generate interest in this relatively unusual application-domain of Neural Networks, geometric algorithms.

By Dr. Vikas Agrawal ~ 1 month ago   reply Reply

Dear Yogesh: Very interesting concept! Could you please help me see where a potential ODSC attendee could use the lower dimensional representation of shapes to save computational time/effort, given that one is adding the computational and memory load of a neural network to the system?

Warm Regards

Vikas

By Yogesh H. Kulkarni ~ 1 month ago   reply Reply

Hello Dr Vikas,

Thanks for your comment and a query.

Here is my response:

> This talk is submitted with an intention to let ODSC attendees be aware of usage of Deep Learning networks for relatively unusual domains such as mechanical engineering, VLSI, etc.

> Simple example would be, to find deflection of a section (say, "I" section of railway tracks) under certain load conditions. The section is meshed with planar (2D) cells, then matrix computation is done to find deflections, stresses, etc. Instead of the 2D section, if its 1D counterpart, ie midcurve/skeleton is computed then the meshing reduces to curve (1D) cells, thus reducing computation and memory effectively, but not compromising too much on the accuracy of results.

> Research and usage of midcurves is going on for more than 6 decades, but largely using rule based computational geometric algorithms. This talk suggests use of Encoder Decoder network, which, in my opinion, is a novel way.

> Other applications of Midcurves are:
> - Pattern recognition of digital images

- Analysis of VLSI designs
- Path generation for pocket machining
- Shape blending in computer animation
- Robotic motion planning
- Biological shape analysis
- Manufacturing planning and manufacturability analysis

More details on applications can be seen in
https://www.researchgate.net/publication/312846624_Medial_Axis_Transform_MAT_of_General_2D_Shapes_and

Thanks again,

Yogesh