

Improving The Inference Capability of DrawCAD:A Program for recognizing mouse drawn engineering drawing

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R&D report

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1 Work Done

1.1 Making equal lines, parallel if they are close to each other and looks parallel

Input: Given two line segments as input and suppose user gives a hard constraint to make them equal line.

Output: Program will make these two line as equal . It will also infer whether user wants two line segments to be parallel or not. The decision strategy is as follows.

first **distance between the two segment** is calculated which is the the distance d between the midpoint of the two line segments .

Average length of two line segment L_{av} is calculated as:

$$L_{av} = \frac{L_1 + L_2}{2} \quad (1)$$

difference between orientation of two line segments from the horizontal $\Delta\theta$ is calculated as :

$$\Delta\theta = |\theta_1 - \theta_2| \quad (2)$$

where θ_1 and θ_2 are the orientation of first and second line segments from the horizontal.

parallel constraints is added or inferred if following condition holds:

$$\text{if } d \leq \alpha \times L_{av} \ \&\& \ \Delta\theta \leq \theta_{thres}$$

where α is the multiplicative factor that will decide what should be tolerance limit for d and θ_{thres} will decide the tolerance limit for $\Delta\theta$. These value can be added to *DrawCAD.property* file by allowing the user to make changes to these factors for better control.

1.2 Making parallel lines, equal if they are close to each other and looks almost equal

Input: Given two line segments as input and suppose user gives a hard constraint to make them parallel line.

Output: Program will make these two line as parallel . It will also infer whether user wants two line segments to be equal or not. The decision strategy is as follows.

firstly, similar to the section 1.1 **distance between the two segment** d is which is the distance between the midpoint of two line segment.

similarly, **Average length** of two line segment L_{av} is calculated using equation 1

difference between length of two line segments ΔL is calculated as :

$$\Delta L = |L_1 - L_2| \quad (3)$$

where L_1 and L_2 are the length of first and second line segments.
equal constraints is added or inferred if following condition holds:

$$\text{if } d \leq \alpha \times L_{av} \ \&\& \ \Delta L \leq L_{thres}$$

where L_{thres} will decide the tolerance limit for ΔL . It is also added to *DrawCAD.property* file.

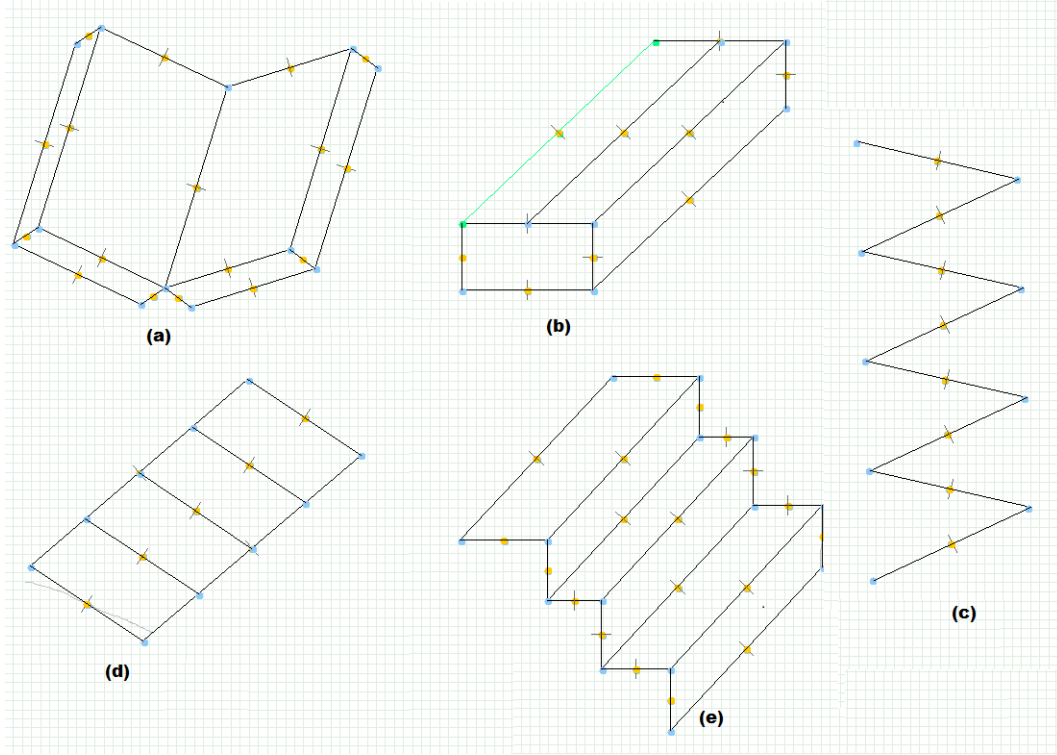


Figure 1: Motivational examples

1.3 Motivation

The prime motivation for this work is that a lot of Engineering Drawing figures have similarity and symmetry among various strokes or user might

want to draw some patterns which is very common in these Drawing. So we wanted to make some modification to our DrawCAD program that can capture such type of inferences. Figure 1 shows some of Figures or Examples motivates us to do this work .

2 Work To be done

2.1 Making two equal line segment perpendicular if almost perpendicular

This may happen user want sometime equal and perpendicular line , in figure 1.2 (c) user may want zig zag pattern containing perpendicular and equal lines .

2.2 capturing all the above inference after nudging

This may happen sometimes, that user does not draw line almost parallel and want to make them parallel, after applying equal length constraint (section 1.1), and nudges one line segment such that it is almost parallel to other in order to make them parallel.

Also, user does not draw line almost equal to other and want to make equal line, after applying parallel line constraint (section 1.2), and nudges one line to make equal to other line.

Also it may happen user does not draw a line almost perpendicular (section 2.1) and nudges the line to make them perpendicular. These type of inferences should be captured.

2.3 Revert or undo operation

Sometime user may not want to DrawCAD proper to infer or guess these constraints, as (section 1.1) user wants only equal line constraints, not the parallel line constraint; or as (section 1.2) user want only parallel line constraint without implicitly making them equal ; similarly in case (Section 2.1). Thus a revert or undo operation should remove only the implicit constraint that were inferred by our DrawCAD program , hence giving the user good command over the Drawing.

2.4 perpendicularity at any intersection point on the two lines

Current DrawCAD implement does not allow user to make perpendicular line at any intersection points, it allows at allow only at end points. we wanted to capture the perpendicularity at any intersection points as shown in Figure 2 .

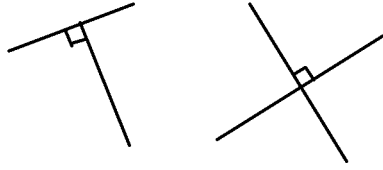


Figure 2: perpendicularity Constraints

2.5 equidistant parallel line set

As in Figure 1(d) Ladder example user may want to make horizontal lines of ladder to be equally spaced . This type of inference should be captured by the program .

However, current implementation of DrawCAD program does not have this type of constraint , we will make the spaces between two set of parallel line equal without adding a Hard constraints, or a Hard constraint can be introduce to capture this type of inference which is not common like equal or parallel or perpendicular constraints. Figure 3 shows what we want to infer .

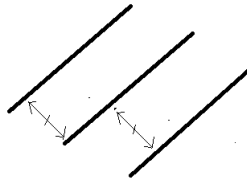


Figure 3: equidistant Constraints

One another method could be breaking the line segment to small line segment and making them equal i.e. if the line has anchor points other than end points then divide the line into two line segment and make them collinear segment .