2D Planner

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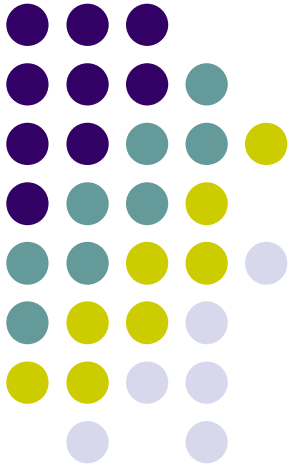
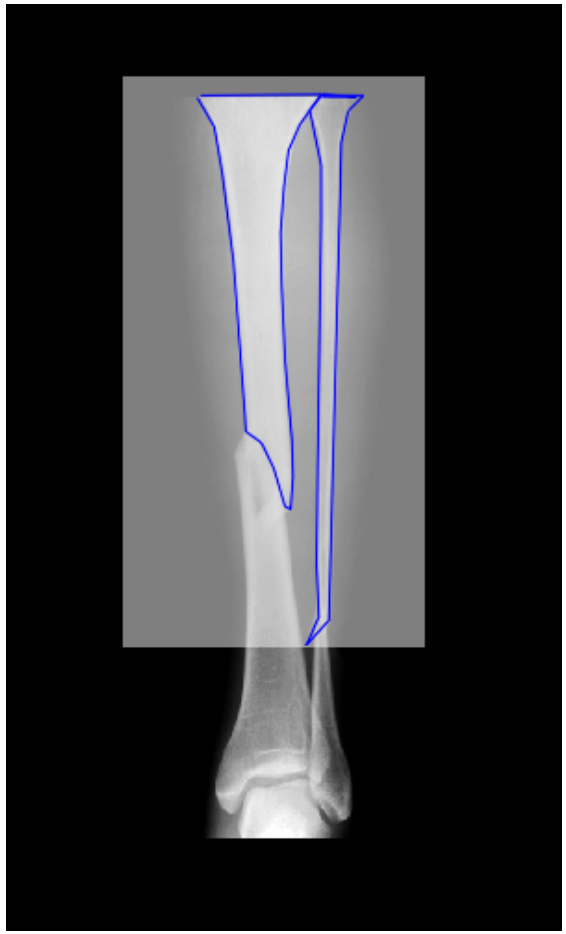


Introduction

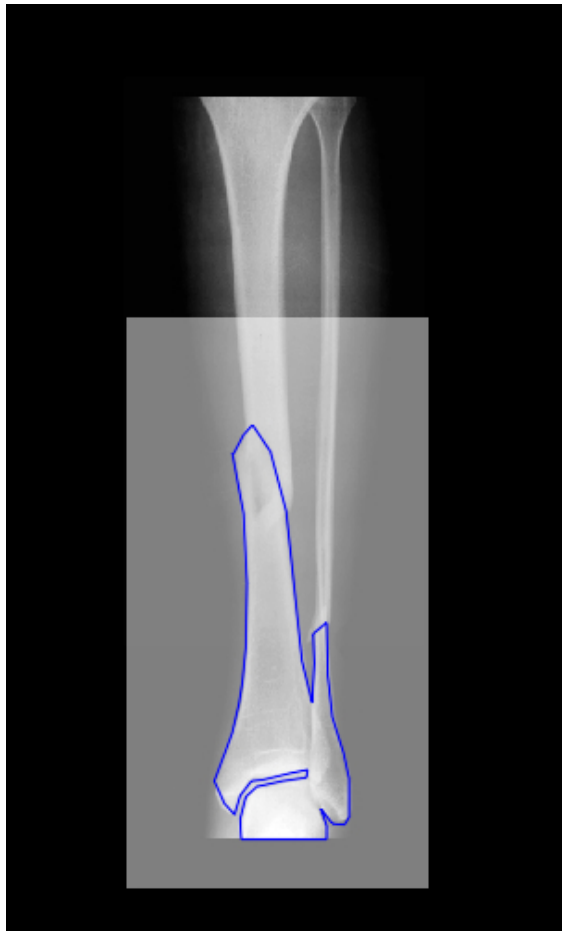
- **Basic problem**: How to put back a broken bone to its original place
- **Present method**: Surgeon solves the problem in his/her mind, and draws the necessary implants on a paper and moves it to a correct position
- **Problems with the method**:
  - Not precise
  - Time consuming

Present method

Present method



Present method



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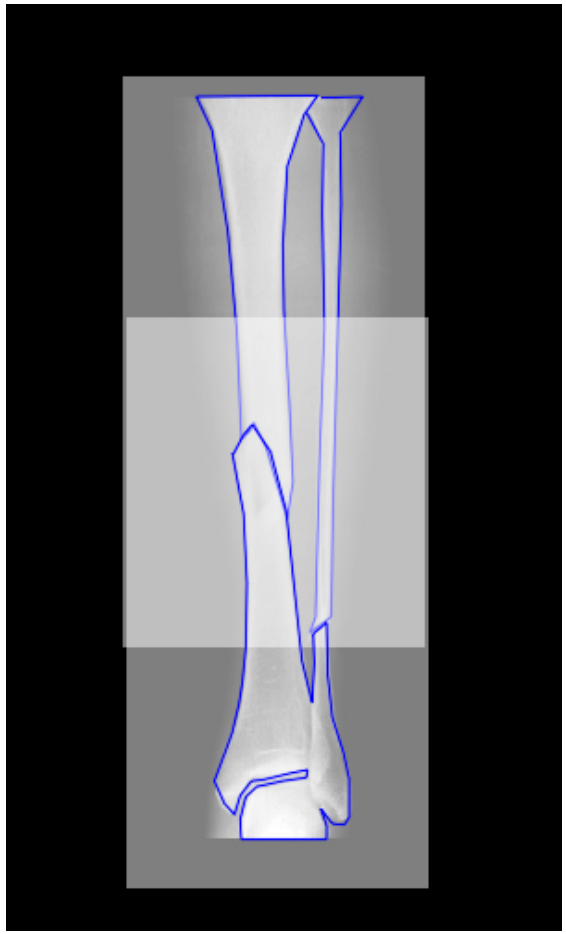

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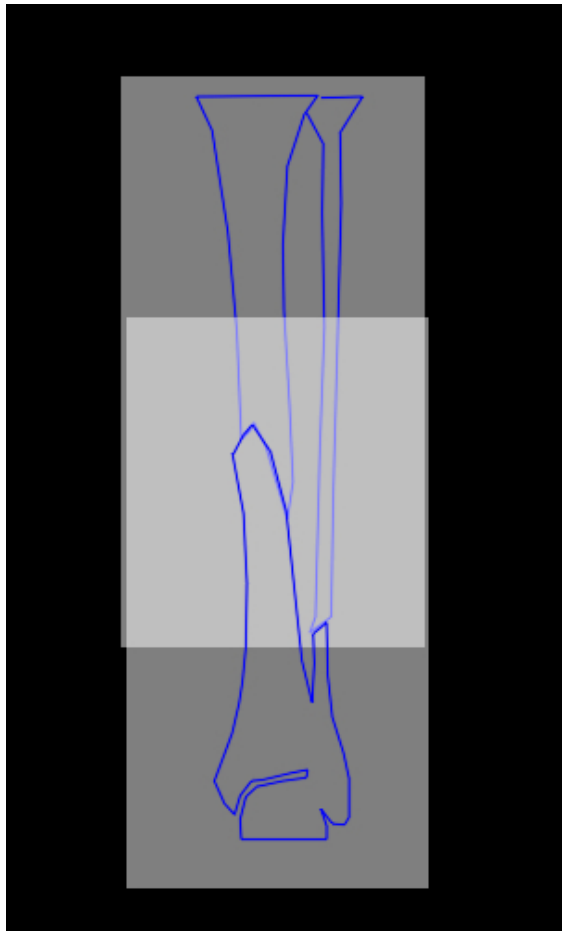

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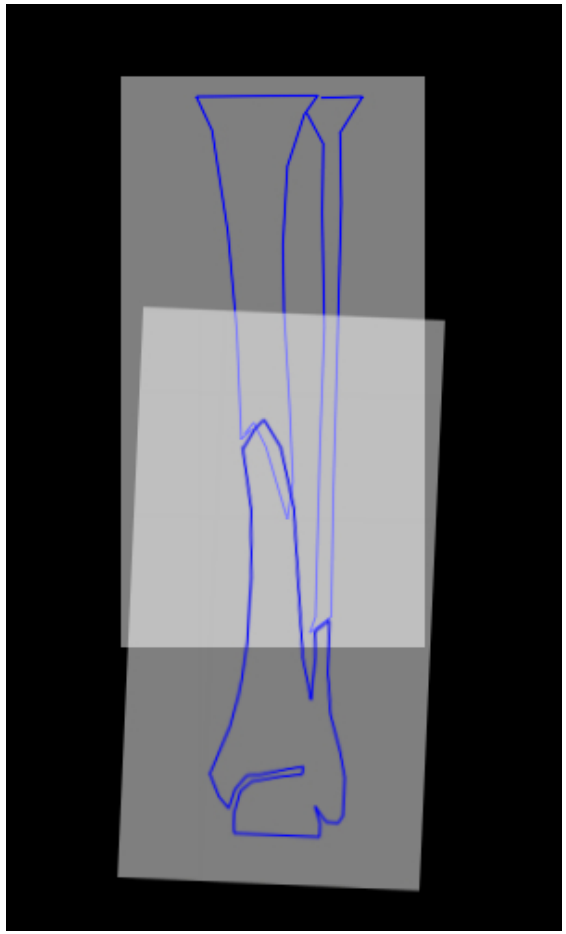

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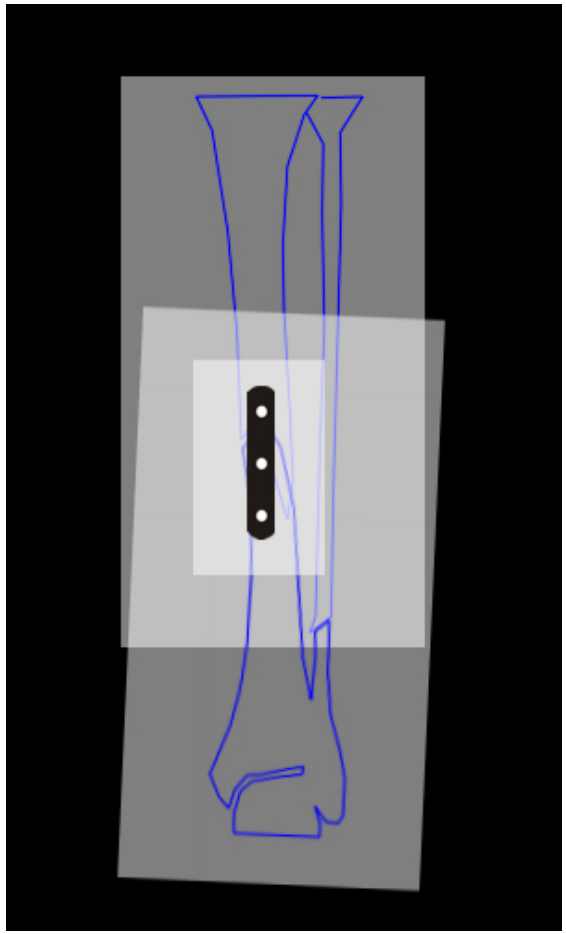

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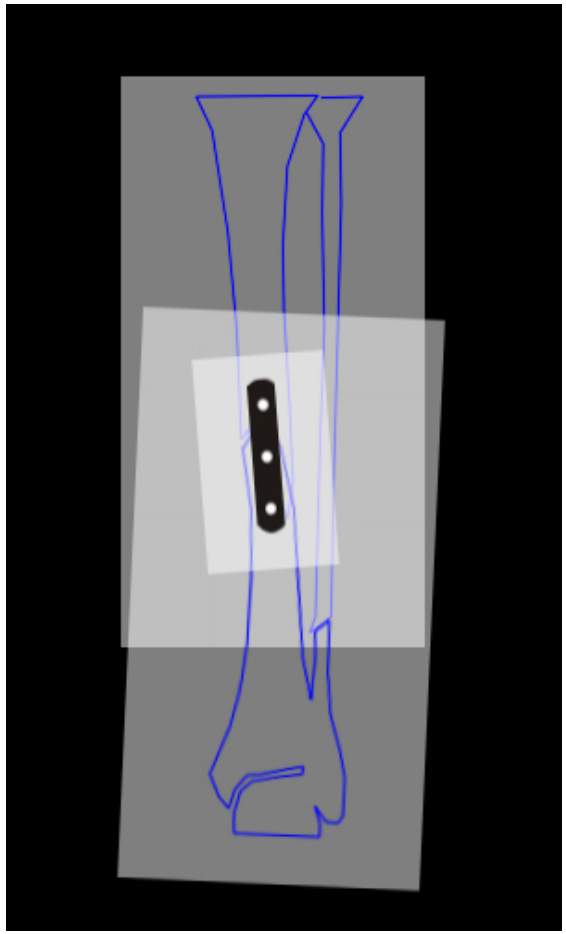

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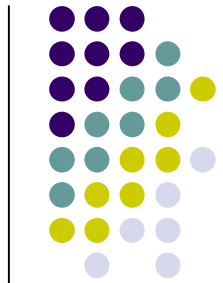


- A software which helps the surgeon to solve the problem in a faster and reliable way giving much precise result
- Programmed in C++
- Uses GUI
- At present works only with PGM and BMP formats

2D Planner in use

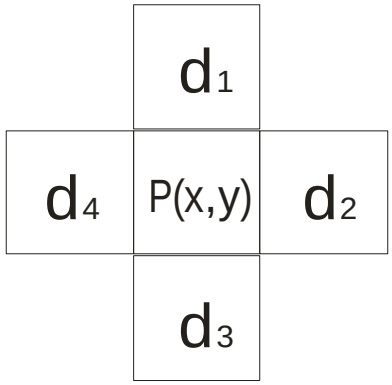
- Main steps:
  - Getting the picture
  - Segmentation
  - Marking the broken areas
  - Separating the broken bone parts
  - Giving axis lines
  - Moving them to the correct position
  - Adding implants if needed

Segmentation

- Using region growing algorithm
- We have to give x,y coordinates and a sensitivity number (S)
- For each 1 <= i <= 4:

  If $|d_i - P(x,y)| < S$ then

  Sign up d_i to the segmented area

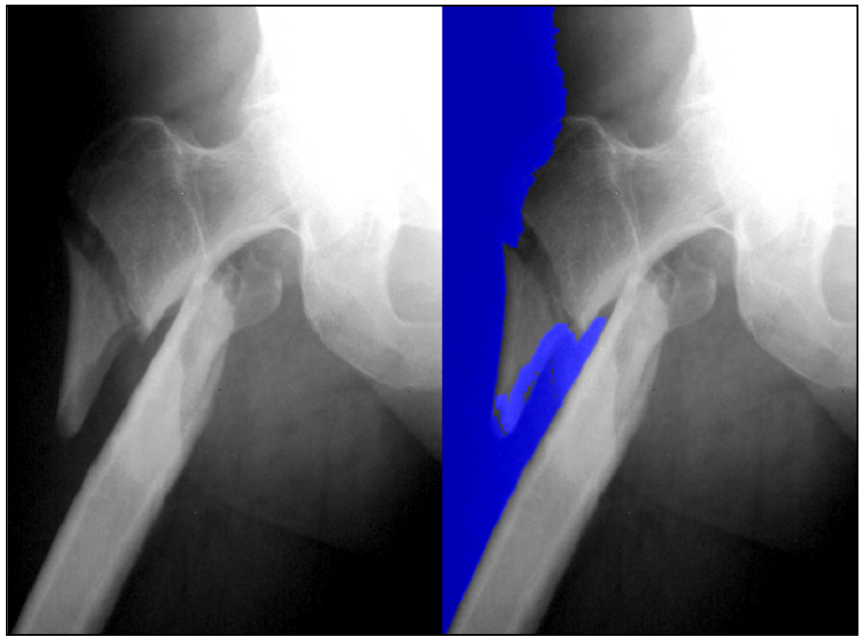


Segmentation

- Control points need to be given (shown with crosses)
- It’s better to give background area points (and invert the segmentation mask later)

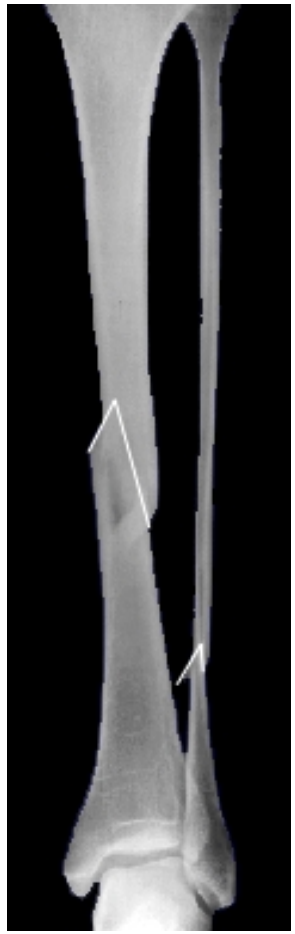
Segmentation

- Problems:
  - Difficulties of finding the correct sensitivity numbers
  - Separating hard-to-segment areas
  - Result depends on the given control points

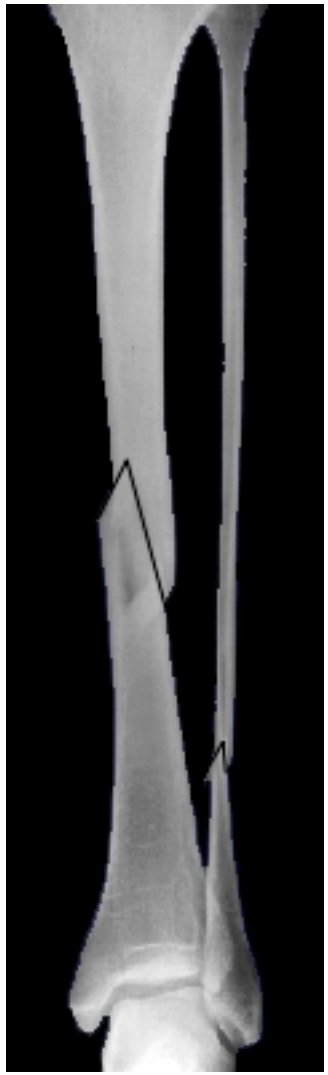


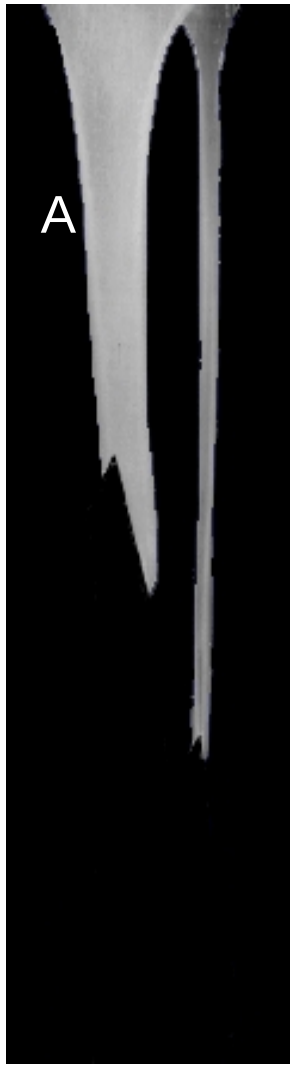
Marking the broken areas

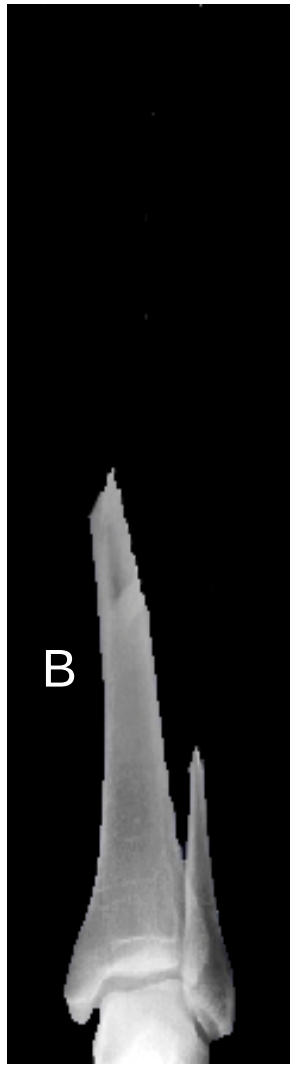
- Mark the areas with the help of user-defined lines



Separating the broken bones





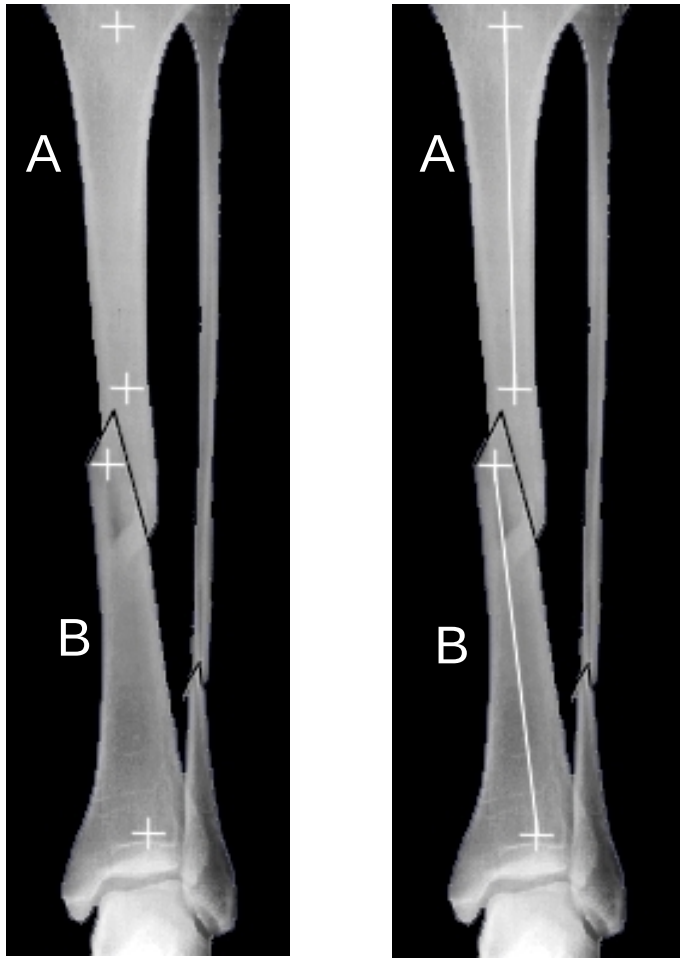


Giving axis lines

- Giving 4 points to get the angle of fracture

- Output example:

  Angle between A and B:
  8.7°



Moving the parts

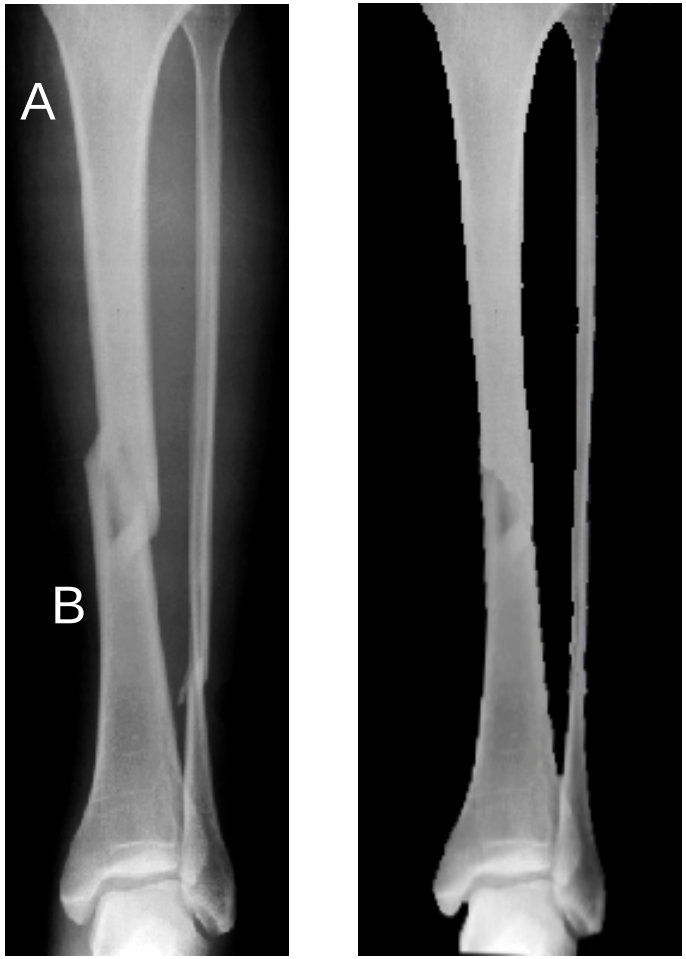
- Using rotation and moving to get the result
- Saving the result
  - Saving the picture
  - Saving the angles and positions
  - Saving transformations

Output example:

Angle between A and B: 8.7°

B moved by 3,-2 (x,y) (relative)

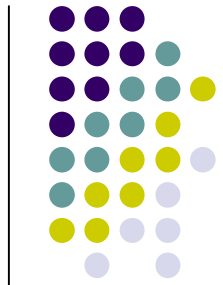
B rotated 8,7 °



Present situation – what needs to be done

- GUI not finished (no GUI at all)
- Slicing the bones not yet finished, needs improving, maybe adding freehand tools
- Effective undo – redo system
- Getting the implants from a database
- Unit measurement (rulers)
- Zoom

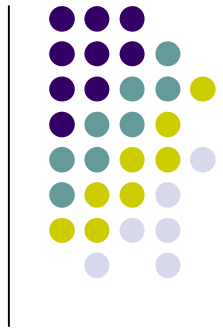
Future plans, extra features



- Reading different picture formats, not just BMP and PGM (like TIFF,TGA,GIF… mainly losless image formats)
  - In case of JPG formats the segmentation algorithm gives bad results because of teh compression type
- Platform independent system ->JAVA Swing (now only available on Windows)
- Automatisation using artificial intelligence
  - For putting the broken bones back to their place with the use of the axis results

Future plans, extra features

- Constructing and using more segmentation algorithms (hopefully more effective)
- Using different filters for removing disturbing areas



Thank you for your patience!