碎纸片的拼接复原

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摘要

首先对图片进行灰度化处理，提取图像的灰度值信息，并建立不同碎片之间的相关性联系，再对图像进行匹配实验，并辅以人工干预。将各个碎片拼接起来。

针对问题一，找到两列之间的相关性，当相关性最大时，对应两张图片可以左右拼接。经计算，得到附件1的拼接结果见表result1.csv。附件2的拼接结果见表result2.csv。

针对问题二，首先根据每张纸片内容的不同特性，将每张纸片分成不同的的行；对于每一行图片，按照问题一的模型与算法，即列相关性最大则进行左右拼接，对于没有拼接到组合里的碎纸片进行人工干预；对于拼接好的每行图片，按照问题一的模型与算法，即行相关性最大则进行上下拼接,对于没有拼接到组合里的碎纸片进行人工干预。我们最终经计算，附件3的拼接结果见表result3.csv，附件4的拼接结果见表result4.csv。

针对问题三，由于图片区分正反两面，在问题二的基础上，增加反面的相关性分析，利用计算机自动拼接与人工干预相结合，对所有图片进行拼接复原。经计算，附件5的拼接结果见表result5.csv。

关键词: 图像拼接　　相关度分析　　滤波

1　问题重述

碎纸片的拼接复原技术在司法鉴定、历史文献修复与研究、军事情报获取以及故障分析等领域都有着广泛的应用。近年来，随着德国“斯塔西”文件的恢复工程的公布，碎纸文件复原技术的研究引起了人们的广泛关注。传统上，拼接复原工作需由人工完成，准确率较高，但效率很低。特别是当碎片数量巨大，人工拼接很难在短时间内完成任务。随着计算机技术的发展，人们试图开发碎纸片的自动拼接技术，以提高拼接复原效率。对于一页印刷文档，针对不同的破碎方法，讨论下列三个问题：

（1）将给定的一页印刷文字文件纵切，建立碎纸片拼接复原模型和算法，并针对附件1、附件2给出的中、英文各一页文件的碎片数据进行拼接复原。

（2）对于碎纸机既纵切又横切的情形，设计碎纸片拼接复原模型和算法，并针对附件3、附件4给出的中、英文各一页文件的碎片数据进行拼接复原。

（3）对于双面打印文档，研究如何进行碎纸片的拼接复原问题。附件5给出的是一页英文印刷文字双面打印文件的碎片数据。要求尝试设计相应的碎纸片拼接复原模型与算法，并就附件5的碎片数据给出拼接复原结果。

2　模型假设

1. 待拼接的碎纸片来自同一页印刷文字文件；

2. 待拼接复原的碎纸片是规整的矩形；

3. 模型中的碎纸片长度、宽度和面积都相等；

4. 附件中照片都是同标准拍摄。

3 问题分析

对于本题的总体思路是：

Step1：相对于每个碎片建立一个节点，每个节点初始化有每个碎片的四个边的灰度值向量。

Step2：通过一定的筛选条件找到原图片的四个边的集合，先一步通过相关度把四个边拼接起来，然后人工干预来看效果，然后从四周向中心拼接。这一步可以在问题更普遍的时候取消掉。

Step3：算出每个节点的左边与其他节点的右边、每个节点的右边与其他节点的左边、每个节点的上边与其他节点的下边、每个节点的下边与其他节点的上边的相关度。

Step4：每个节点的四个边的每个相关度根据条件保留下来。

Step5：找到某个相关度最大的节点，以此为种子，向四方拼接，且拼接时选择的临近节点依靠本节点的相关度依概率选择。

Step6：进行人工干预，查看生成的图片是否正确，根据情况改进算法或者人工改正较少错误时的某几个节点。

4 模型的建立与求解

4.1 问题1的模型建立与求解

使用matlab的imread函数将图片文件导入，生成灰度值矩阵。提取每张图片灰度值矩阵的第一列和最后一列。

由于第一问的特点，我们可以寻找灰度值矩阵第一列全部为255（白色）的那一列，作为拼接的总图片的第一列；寻找灰度值矩阵最后一列全部为255 （白色）的那一列，作为拼接的总图片最后一列。然后利用corrcoef函数，以总图片的最左边第一张对应的子图片起，寻找各子图片当中的第一列与上一张字图片的最后一列的相关系数最大的，作为拼接的下一列。拼接完成，按照拼接的顺序重新导入图片，生成总图片的灰度矩阵y。

4.2 问题1结果

城上层楼叠巘。城下清淮古汴。举手揖吴云，人与暮天俱远。魂断。魂断。后夜松江月满。簌簌衣巾莎枣花。村里村北响繅车。牛衣古柳卖黄瓜。海棠珠缀一重重。清晓近帘栊。胭脂谁与匀淡，偏向脸边浓。小郑非常强记，二南依旧能诗。更有鲈鱼堪切脍，儿辈莫教知。自古相从休务日，何妨低唱微吟。天垂云重作春阴。坐中人半醉，帘外雪将深。双鬟绿坠。娇眼横波眉黛翠。妙舞蹁跹。掌上身轻意态妍。碧雾轻笼两凤，寒烟淡拂双鸦。为谁流睇不归家。错认门前过马。

我劝髯张归去好，从来自己忘情。尘心消尽道心平。江南与塞北，何处不堪行。闲离阻。谁念萦损襄王，何曾梦云雨。旧恨前欢，心事两无据。要知欲见无由，痴心犹自，倩人道、一声传语。风卷珠帘自上钩。萧萧乱叶报新秋。独携纤手上高楼。临水纵横回晚鞚。归来转觉情怀动。梅笛烟中闻几弄。秋阴重。西山雪淡云凝冻。凭高眺远，见长空万里，云无留迹。桂魄飞来光射处，冷浸一天秋碧。玉宇琼楼，乘鸾来去，人在清凉国。江山如画，望中烟树历历。省可清言挥玉尘，真须保器全真。风流何似道家纯。不应同蜀客，惟爱卓文君。自惜风流云雨散。关山有限情无限。待君重见寻芳伴。为说相思，目断西楼燕。莫恨黄花未吐。且教红粉相扶。酒阑不必看茱萸。俯仰人间今古。玉骨那愁瘴雾，冰姿自有仙风。海仙时遣探芳丛。倒挂绿毛么凤。

俎豆庚桑真过矣，凭君说与南荣。愿闻吴越报丰登。君王如有问，结袜赖王生。师唱谁家曲，宗风嗣阿谁。借君拍板与门槌。我也逢场作戏、莫相疑。晕腮嫌枕印。印枕嫌腮晕。闲照晚妆残。残妆晚照闲。可恨相逢能几日，不知重会是何年。茉莫仔细更重看。午夜风翻幔，三更月到床。簟纹如水玉肌凉。何物与侬归去、有残妆。金炉犹暖麝煤残。惜香更把宝钗翻。重闻处，余熏在，这一番、气味胜从前。菊暗荷枯一夜霜。新苞绿叶照林光。竹篱茅舍出青黄。霜降水痕收。浅碧鳞鳞露远洲。酒力渐消风力软，飔飔。破帽多情却恋头。烛影摇风，一枕伤春绪。归不去。凤楼何处。芳草迷归路。汤发云腴酽白，盏浮花乳轻圆。人间谁敢更争妍。斗取红窗粉面。炙手无人傍屋头。萧萧晚雨脱梧楸。谁怜季子敝貂裘。

fair of face.

The customer is always right. East, west, home's best. Life's not all beer and skittles. The devil looks after his own. Manners maketh man. Many a mickle makes a muckle. A man who is his own lawyer has a fool for his client.

You can't make a silk purse from a sow's ear. As thick as thieves. Clothes make the man. All that glisters is not gold. The pen is mightier than sword. Is fair and wise and good and gay. Make love not war. Devil take the hindmost. The female of the species is more deadly than the male. A place for everything and everything in its place. Hell hath no fury like a woman scorned. When in Rome, do as the Romans do. To err is human; to forgive divine. Enough is as good as a feast. People who live in glass houses shouldn't throw stones. Nature abhors a vacuum. Moderation in all things.

Everything comes to him who waits. Tomorrow is another day. Better to light a candle than to curse the darkness.

Two is company, but three's a crowd. It's the squeaky wheel that gets the grease. Please enjoy the pain which is unable to avoid. Don't teach your Grandma to suck eggs. He who lives by the sword shall die by the sword. Don't meet troubles half-way. Oil and water don't mix. All work and no play makes Jack a dull boy.

The best things in life are free. Finders keepers, losers weepers. There's no place like home. Speak softly and carry a big stick. Music has charms to soothe the savage breast. Ne'er cast a clout till May be out. There's no such thing as a free lunch. Nothing venture, nothing gain. He who can does, he who cannot, teaches. A stitch in time saves nine. The child is the father of the man. And a child that's born on the Sab-

4.3 问题2的模型建立与求解

4.3.1 求解思路

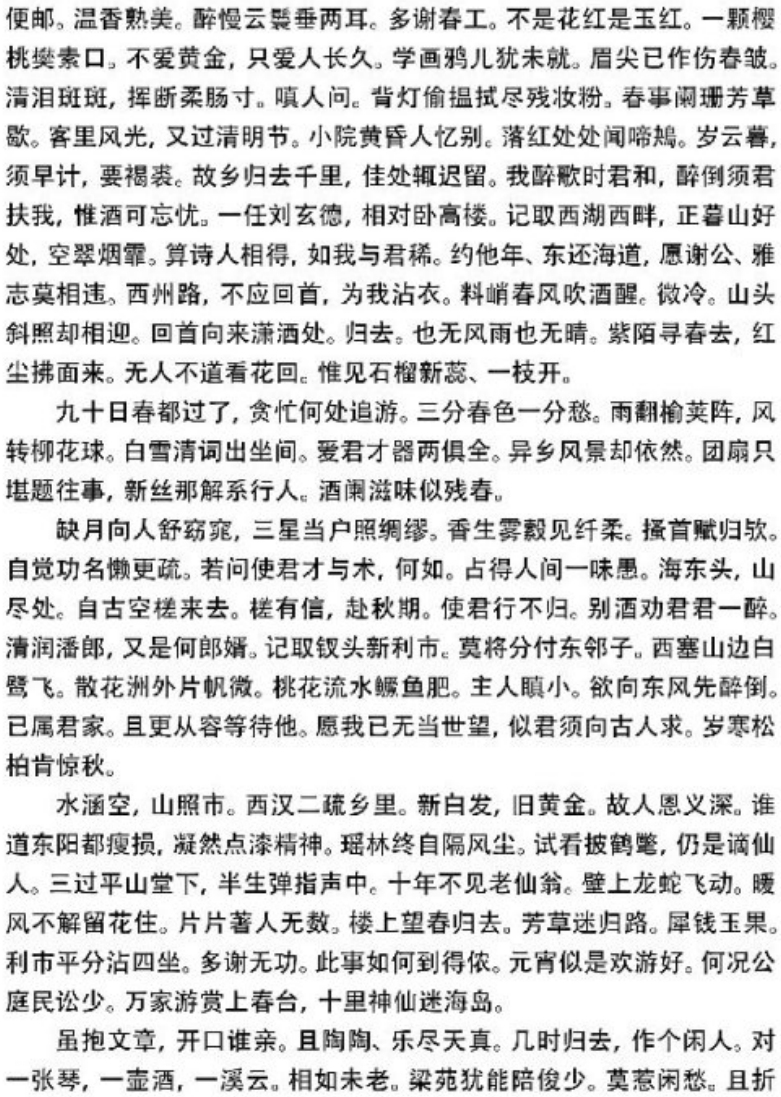
问题二为一张纸片的双向切碎后的碎片拼接问题。沿用第一问解决方案，先将$11 \times 19(209)$张纸片先拼接成11张长条形制片，再使用第第一问策略解决单方向切割的问题。

其中行的拼接中，采用行间距，行字最高点位置等限制条件缩小边沿匹配空间，调高基于边沿策略的匹

配准确度。在列拼接中，采用段间距，行间距等约束条件，配合一定的人工干预（语义判断），从而完成整副图片的拼凑。

值得说明的是，使用先横向拼接再纵向拼接，是因为段落和行间距较大，基于边缘的判断难以成功。其中拼接依据为纸片边缘相异度最小来衡量，但是因为切割变多且在纵向段落拼接的过程中因为段距和行间距的影响，仅仅基于边缘判断的方案出现难以解决，从而需要人工干预。

4.4 问题2结果



便邮。温香熟美。醉慢云鬟垂两耳。多谢春工。不是花红是玉红。一颗樱桃樊素口。不爱黄金，只爱人长久。学画鸦儿犹未就。眉尖已作伤春皱。清泪斑斑，挥断柔肠寸。嗔人问。背灯偷揾拭尽残妆粉。春事阑珊芳草歇。客里风光，又过清明节。小院黄昏人忆别。落红处处闻啼鴂。岁云暮，须早计，要褐裘。故乡归去千里，佳处辄迟留。我醉歌时君和，醉倒须君扶我，惟酒可忘忧。一任刘玄德，相对卧高楼。记取西湖西畔，正暮山好处，空翠烟霏。算诗人相得，如我与君稀。约他年、东还海道，愿谢公、雅志莫相违。西州路，不应回首，为我沾衣。料峭春风吹酒醒。微冷。山头斜照却相迎。回首向来潇洒处。归去。也无风雨也无晴。紫陌寻春去，红尘拂面来。无人不道看花回。惟见石榴新蕊、一枝开。

九十日春都过了，贪忙何处追游。三分春色一分愁。雨翻榆荚阵，风转柳花球。白雪清词出坐间。爱君才器两俱全。异乡风景却依然。团扇只堪题往事，新丝那解系行人。酒阑滋味似残春。

缺月向人舒窈窕，三星当户照绸缪。香生霁靸见纤柔。搔首赋归欤。自觉功名懒更疏。若问使君才与术，何如。占得人间一味愚。海东头，山尽处。自古空槎来去。槎有信，赴秋期。使君行不归。别酒劝君君一醉。清润潘郎，又是何郎婿。记取钗头新利市。莫将分付东邻子。西塞山边白鹭飞。散花洲外片帆微。桃花流水鳜鱼肥。主人瞋小。欲向东风先醉倒。已属君家。且更从容等待他。愿我已无当世望，似君须向古人求。岁寒松柏肯惊秋。

水涵空，山照市。西汉二疏乡里。新白发，旧黄金。故人恩义深。谁道东阳都瘦损，凝然点漆精神。瑶林终自隔风尘。试看披鹤氅，仍是谪仙人。三过平山堂下，半生弹指声中。十年不见老仙翁。壁上龙蛇飞动。暖风不解留花住。片片著人无数。楼上望春归去。芳草迷归路。犀钱玉果。利市平分沾四坐。多谢无功。此事如何到得侬。元宵似是欢游好。何况公庭民讼少。万家游赏上春台，十里神仙迷海岛。

虽抱文章，开口谁亲。且陶陶、乐尽天真。几时归去，作个闲人。对一张琴，一壶酒，一溪云。相如未老。梁苑犹能陪俊少。莫惹闲愁。且折

bath day. No news is good news.

Procrastination is the thief of time. Genius is an infinite capacity for taking pains. Nothing succeeds like success. If you can't beat em, join em. After a storm comes a calm. A good beginning makes a good ending.

One hand washes the other. Talk of the Devil, and he is bound to appear. Tuesday's child is full of grace. You can't judge a book by its cover. Now drips the saliva, will become tomorrow the tear. All that glitters is not gold. Discretion is the better part of valour. Little things please little minds. Time flies. Practice what you preach. Cheats never prosper.

The early bird catches the worm. It's the early bird that catches the worm. Don't count your chickens before they are hatched. One swallow does not make a summer. Every picture tells a story. Softly, softly, catchee monkey. Thought is already is late, exactly is the earliest time. Less is more.

A picture paints a thousand words. There's a time and a place for everything. History repeats itself. The more the merrier. Fair exchange is no robbery. A woman's work is never done. Time is money.

Nobody can casually succeed, it comes from the thorough self-control and the will. Not matter of the today will drag tomorrow. They that sow the wind, shall reap the whirlwind. Rob Peter to pay Paul. Every little helps. In for a penny, in for a pound. Never put off until tomorrow what you can do today. There's many a slip twixt cup and lip. The law is an ass. If you can't stand the heat get out of the kitchen. The boy is father to the man. A nod's as good as a wink to a blind horse. Practice makes perfect. Hard work never did anyone any harm. Only has compared to the others early, diligently

4.5 问题3的模型建立与求解

采用滤波的方法使得图像中的噪声得以去除，同时加入多种限制机制缩小边沿匹配的选择范围，提高准确率。

在尽量保留图像细节特征的条件下对目标图像的噪声进行抑制，是图像预处理中不可缺少的操作，其处理效果的好坏将直接响到后续图像处理和分析的有效性和可靠性。滤波就是要去除没用的信息，保留有用的信息，可能是低频，也可能是高频。

滤波的目的有两个:一是抽出对象的特征作为图像识别的特征模式; 另一个是为适应图像处理的要求，消除图像数字化时所混入的噪声。对滤波处理的要求有两条:一是不能损坏图像的轮廓及边缘等重要信息;二是使图像清晰视觉效果好。

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4.6 问题3结果

What can't be cured must be endured. Bad money drives out good. Hard cases make bad law. Talk is cheap. See a pin and pick it up, all the day you'll have good luck; see a pin and let it lie, bad luck you'll have all day. If you pay peanuts, you get monkeys. If you can't be good, be careful. Share and share alike. All's well that ends well. Better late than neve[illegible]ish always stink from the head down. A new broom swee[illegible]ty· clean. April showers bring forth May flowers. It never ra[illegible]tru· but it pours. Never let the sun go down on your anger.

Pearls of wisdom. The proof of the pudding is in the eating. Parsley seed goes nine times to the Devil. Judge not, that ye be not judged. The longest journey starts with a single step. Big fish eat little fish. Great minds think alike. The end justifies the means. Cowards may die many times before their death. You can't win them all. Do as I say, not as I do. Don't upset the apple-cart. Behind every great man there's a great woman. Pride goes before a fall.

You can lead a horse to water, but you can't make it drink. Two heads are better than one. March winds and April showers bring forth May flowers. A swarm in May is worth a load of hay; a swarm in June is worth a silver spoon; but a swarm in July is not worth a fly. Might is right. Let bygones be bygones. It takes all sorts to make a world. A change is as good as a rest. Into every life a little rain must fall. A chain is only as strong as its weakest link.

Don't look a gift horse in the mouth. Old soldiers never die, they just fade away. Seeing is believing. The opera ain't over till the fat lady sings. Silence is golden. Variety is the spice of life. Tomorrow never comes. If it ain't broke, don't fix it. Look before you leap. The road to hell is paved with good

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5 模型的优缺点

优点：

- 问题一的模型对于解决纵切碎纸片的问题上，达到了很好的效果，对于所得的结果正确率也是100
- 问题二的模型充分考虑了碎纸片边缘的匹配问题以及文字内部的特征信息，对于既纵切又横切的情形，先得到每行的集合，然后拼接成行，大大减少了工作量，而且增加了准确度；

缺点：

- 对于问题一与问题二，所给的完整图片里面含有大量的的文字，所以我们可以利用其文字特征，该结果也存在一定的偶然性；
- 对于问题三，对于大信息量的图片信息，只利用问题二的解决办法只能将部分的图片进行分类，而不能单纯用计算机进行完整的拼接；

6 模型的改进方向

（1）在问题一里面我们只考虑了边缘区域的匹配，由于结果正确所以没有继续增加条件保证其准确率。

（2）可以考虑聚类的方法和贪心算法以改进模型。

（3）对于图像预处理和图像特征的处理可能还有更好的方法。

（4）图像识别中适当加入语义识别的部分。

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附录

附录1　guihua.m

```
a=[142.46 5018.36 323 ;
24.29 612.76 7 ;
150.17 4018.26 985 ;
103.99 2253.69 286 ;
238.64 4287.86 205 ;
44.63 701.66 3 ;
62.5 920.59 6 ;
167.28 2401.82 180 ;
325.78 3612.18 346] ;

x1=a(:,1);
x2=a(:,2);
y=a(:,3);
X=[ones(9,1),x1,x2];
cftool
%b=regress(y,X)
```

附录2　quhua.m

```
data;
a=data1(:,1);
b=data1(:,2);
scatter(a,b,'.')

longgang=0;
luohu=0;
futian=0;
nanshan=0;
baoan=0;
longhua=0;
guangming=0;
yantian=0;
pingshan=0;

for i=1:2000;
if a(i,1)>=114.108254 && a(i,1)<=114.216626 && b(i,1)>=22.53873 && b(i,1)<=22.590794
    luohu=luohu+1;
end
```

```
if a(i,1)>=114.009656 && a(i,1)<=114.216626 && b(i,1)>=22.517231 && b(i,1)<=22.589726
    futian=futian+1;
end

if a(i,1)>=113.88993 && a(i,1)<=114.009656 && b(i,1)>=22.49052 && b(i,1)<=22.60374
    nanshan=nanshan+1;
end

if a(i,1)>=113.775953 && a(i,1)<=113.927156 && b(i,1)>=22.54821 && b(i,1)<=22.808845
    baoan=baoan+1;
end

if a(i,1)>=113.879438 && a(i,1)<=113.994564 && b(i,1)>=22.725267 && b(i,1)<=22.818839
    guangming=guangming+1;
end

if a(i,1)>=113.973724 && a(i,1)<=114.096756 && b(i,1)>=22.599069 && b(i,1)<=22.766996
    longhua=longhua+1;
end

if a(i,1)>=114.223237 && a(i,1)<=114.340807 && b(i,1)>=22.551948 && b(i,1)<=22.64057
    yantian=yantian+1;
end

if a(i,1)>=114.295102 && a(i,1)<=114.435668 && b(i,1)>=22.632831 && b(i,1)<=22.766196
    pingshan=pingshan+1;
end

if a(i,1)>=114.057661 && a(i,1)<=114.335633 && b(i,1)>=22.599736 && b(i,1)<=22.819505
    longgang=longgang+1;
end

if a(i,1)>=114.334771 && a(i,1)<=114.594201 && b(i,1)>=22.470082 && b(i,1)<=22.670854
    longgang=longgang+1;
end

end
```

附录3　readdata-fromcsv.m

```
data1=zeros(2000,2);
for i=1:2000
    g=['cabin (' num2str(i) ').csv'];
    data1(i,:) = xlsread(g,1,'C2:D2');
    i
end
```

附录4　shijian.m

```
rate=zeros(10,24);
for i=1:1:10
    g=['cabin (' num2str(i) ').csv'];
    data1 = readtable(g);
    data = table2cell(data1);    %??table×a??3é cell'
    data(:,8)=[];
    %b=str2num(char(data))
    % a=find(data(:,2)<'2011/04/18 01:00:00');
    scale=size(data);
    n=scale(1);
    state=data(:,5);
    state=cell2mat(state);
    date = datevec(data(:,2));
    count=zeros(24,1);
    load=zeros(24,1);
    for j=1:n
        count(date(j,4)+1)=count(date(j,4)+1)+1;
        if state(j,1)==1
            load(date(j,4)+1)=load(date(j,4)+1)+1;
        end
    end
    a=load./count;
    rate(i-50,:)=a';
end
```

附录5　SHOW-HEAD.m

```
Row = 11;

% HEAD = [8,15,30,39,50,62,72,90,95,126,169];
HEAD = test;
SizeHEAD = size(HEAD);
```

```
gap = 71;
head = 1;

for i=1:SizeHEAD(2)
    Picture(:,head:head+gap) =  TU(:,:,HEAD(i));
    head = head + gap;
end

figure( );
imshow(Picture);
```

附录6　Probelm.m

```
%Caculate
%%
%图片大小 180x72
%拼出来图片 11x19
clear;clc;

S_r = 180;
S_c = 72;
Row = 11;
Column = 19;
NUM = Row*Column;

for i=1:NUM
   TU(:,:,i) = imread(strcat('t (',strcat(strcat(num2str(i),')'),'.bmp')));
   tu(:,:,i) = im2double(TU(:,:,i));
end

tuu(:,:,:) = tu(:,:,:);

for i=1:NUM
    for j=1:S_r
        for k=1:S_c
            if tu(j,k,i) < 0.1
                tu(j,k,i) = 0;
            else
                if tu(j,k,i) >0.8
                   tu(j,k,i) =1;
                end
```

```
            end
        end
    end
end

for i=1:NUM
   A(:,i) = tu(:,1,i);  %左
   B(:,i) = tu(:,72,i); %右
   C(:,i) = tu(1,:,i);  %上
   D(:,i) = tu(180,:,i);  %下
end

Strat_u = zeros(1,S_c) +1;  %上侧全白
Strat_l = zeros(1,S_r) +1;  %左侧全白

start_L = []; num_L = 1;
start_U = []; num_U = 1;
end_R = []; num_R = 1;

for i=1:NUM
    if A(:,i) == Strat_l
        start_L(num_L) = i;
        num_L = num_L+1;
    end

    if B(:,i) == Strat_l
        end_R(num_R) = i;
        num_R = num_R+1;
    end

    if C(:,i) == Strat_u
        start_U(num_U) = i;
        num_U = num_U+1;
    end
end

%%
%开头
piexl = 12;
Strat_pl = zeros(S_r,piexl) +1;  %左侧全白
```

```
NAN_num = 0;

for i=1:(num_L-1)
%     Temp = TU(:,1:piexl,start_L(i));
%     temp = im2double(Temp);
    if   ~isequal(tu(:,1:piexl,start_L(i)),Strat_pl)
        start_L(i) = inf;
        NAN_num = NAN_num +1;
    end
end

head_L = [];
num = 1;

for i=1:(num_L-1)
    if start_L(i) ~= inf
        head_L(num) = start_L(i);
        num = num +1;
    end
end


%%
%结尾
piexl = 6;
End_pl = zeros(S_r,piexl) +1;  %右侧全白
NAN2_num = 0;

for i=1:(num_R-1)
%     Temp = TU(:,1:piexl,start_L(i));
%     temp = im2double(Temp);
    if   ~isequal(tu(:,1:piexl,end_R(i)),End_pl)
        End_pl(i) = inf;
        NAN2_num = NAN2_num +1;
    end
end

tail_R = [];
num = 1;
```

```
for i=1:(num_R-1)
    if start_L(i) ~= inf
        tail_R(num) = end_R(i);
        num = num +1;
    end
end

%%
for i=1:NUM
    for j=1:NUM
        Result (i,j) = sum(abs(A(:,i) - B(:,j)));
    end
end

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
load('position.mat');
Copy_Result(:,:) = Result(:,:);
Size_test = size(test);

for i=1:Row
%    Result(tail_R(i),:) = inf(NUM,1);
    Result(head_L(i),:) = inf(NUM,1);
end

%test=[62 7 20 21 37 53 64 68 70 73 79 80 97 100 117 132 163 164 178];

for i=1:NUM
    flag = 0;
    for j=1:Size_test(2)
        if test(j) == i
            flag = 1;
        end
    end
    if flag == 0
        Result(i,:) = inf(NUM,1);
    end
end
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

```
num = 2;
Head = head_L(2);
picture_I = [Head];
while num <= Column
    [temp,Head_I] = min(Result(:,Head));
    picture_I(num) = Head_I;
    Result(Head_I,:) = inf(NUM,1);
    Head = Head_I;
    num = num +1;
%     if Head == 14
%        picture_I(num) = 183;
%              Result(Head,:) = inf(NUM,1);
%         Head = 183;
%         num = num +1
%     end
%     if Head == 84
%        picture_I(num) = 133;
%              Result(Head,:) = inf(NUM,1);
%         Head = 133;
%         num = num +1
%     end
end

Result_tail = [];
for i=1:Row
        Result_tail (1,i) = sum(abs(A(:,picture_I(num-1)) - B(:,1)));
end


gap = 71;
head = 1;
for i=1:Column
    Picture(:,head:head+gap) =  TU(:,:,picture_I(i));
    head = head + gap;
end

figure( );
imshow(Picture);
```

附录6　Probelm.m

```
Probelm2-2.m
%Caculate
%%
%图片大小 180x72
%拼出来图片 11x19
clear;clc;

S_r = 180;
S_c = 72;
Row = 11;
Column = 19;
NUM = Row*Column;

for i=1:(NUM*2)
   TU(:,:,i) = imread(strcat('t (',strcat(strcat(num2str(i),')'),'.bmp')));
   tu(:,:,i) = im2double(TU(:,:,i));
end



% for i=1:NUM
%     for j=1:S_r
%         for k=1:S_c
%             if tu(j,k,i) < 0.5
%                 tu(j,k,i) = 0;
%             else
%                 if tu(j,k,i) >0.5
%                    tu(j,k,i) =1;
%                 end
%             end
%         end
%     end
% end
position = [];
num_t = 1;

Compression  = [];

for i=1:NUM
    Compression(:,i) = mean(tu(:,:,i)')';
end
```

```
for i=1:NUM
   for k=1:S_c
       for j=1:S_r
           if tu(j,k,i) == 0
               temp(num_t) = j;
               num_t = num_t + 1;
               break;
           end
       end
   end
   position(i) = min(temp);
   temp = [];
   num_t = 1;
end
%%
test = [];
num_test = 1;
% for i=1:NUM
%     if (position(i)<100)&&(position(i)>=0)
%         test(num_test) = i;
%         num_test = num_test +1;
%     end
% end
%%
% 1----------(Compression(33:54,i),GAP)
% 3----------(Compression(75:99,i),GAP)
% 4----------(Compression(21:42,i),GAP) (Compression(88:109,i),GAP)
% 5----------(Compression(151:172,i),GAP) (Compression(81:102,i),GAP) (Compression(14:
%%
GAP = zeros(6,1) +1;
GAP2 = zeros(24,1) +1;
for i=1:NUM
    if isequal (Compression(1:6,i),GAP)
          if isequal(Compression(49:72,i),GAP2)
                test(num_test) = i;
                num_test = num_test +1;
          end
    end
end
```

```
%%
% SAVE
save position.mat
```