dm3_to_metajpg_200609

June 9, 2020

1 TEM(.dm3) and SEM(.tif) to .jpg with metadata

- hyperspy : http://hyperspy.org/hyperspy-doc/current/user_guide/getting_started.html#starting-hyperspy-in-the-notebook-or-terminal
- scikit-image (>=0.14.2) : https://scikit-image.org/
- piexif : https://github.com/hMatoba/Piexif
- Pillow : https://pillow.readthedocs.io/en/stable/
- matplotlib-scalebar : https://github.com/ppinard/matplotlib-scalebar

1.0.1 1. Import libararies

[1]:
```
# Import libaries

import numpy as np
import matplotlib
import matplotlib.pyplot as plt
import skimage
import hyperspy.api as hs
import hyperspy.drawing.image as hsi
import os, copy
from PIL import Image
from PIL.TiffTags import TAGS
import json

%matplotlib inline
#%matplotlib qt for GUI image output
```

```
/opt/conda/lib/python3.7/site-packages/statsmodels/tools/_testing.py:19:
FutureWarning: pandas.util.testing is deprecated. Use the functions in the
public API at pandas.testing instead.
  import pandas.util.testing as tm
```

1.0.2 2. Doing chores

[2]:
```
# turn off hyperspy warning signs

hs.preferences.GUIs.warn_if_guis_are_missing = False
hs.preferences.save()
```

[3]:
```
# find working directory

pwd = os.getcwd()
print(pwd)
```

```
/workplace/01_KIER_Computational/04_Projects/2018_           /190618_Im
ageMetadata
```

1.0.3 3. Function : Metadata Extraction

- input : input file name
- output : metadata (dictionary type)

[4]:
```
def extmeta_dm3(infilename):

  im = hs.load(infilename)
  # File name
  filename = im.metadata.General.original_filename

  # Instrument
  microscope = im.original_metadata.ImageList.TagGroup0.ImageTags.
↪Microscope_Info.Microscope
  mode_acq = im.metadata.Acquisition_instrument.TEM.acquisition_mode
  mode_img = im.original_metadata.ImageList.TagGroup0.ImageTags.Microscope_Info.
↪Imaging_Mode
  beam_nrg = im.metadata.Acquisition_instrument.TEM.beam_energy

  # Acquisition
  acq_date = im.original_metadata.ImageList.TagGroup0.ImageTags.DataBar.
↪Acquisition_Date
  acq_time = im.original_metadata.ImageList.TagGroup0.ImageTags.DataBar.
↪Acquisition_Time
  exp_time = im.original_metadata.ImageList.TagGroup0.ImageTags.DataBar.
↪Exposure_Time_s
  intensity_max = im.original_metadata.ImageList.TagGroup0.ImageTags.
↪Acquisition.Frame.Intensity.Range.Maximum_Value_counts
  intensity_min = im.original_metadata.ImageList.TagGroup0.ImageTags.
↪Acquisition.Frame.Intensity.Range.Minimum_Value_counts
```

```
 # Image
 mag = im.metadata.Acquisition_instrument.TEM.magnification
 binning = im.original_metadata.ImageList.TagGroup0.ImageTags.Acquisition.
↪Frame.Area.Transform.Transform_List.TagGroup0.Binning
 #intensity_max = im.original_metadata.ImageList.TagGroup0.ImageTags.
↪Acquisition.Frame.Intensity.Range.Mininum_Value

 scale_x = im.original_metadata.ImageList.TagGroup0.ImageData.Calibrations.
↪Dimension.TagGroup0.Scale
 scale_y = im.original_metadata.ImageList.TagGroup0.ImageData.Calibrations.
↪Dimension.TagGroup1.Scale
 scale_unit = im.original_metadata.ImageList.TagGroup0.ImageData.Calibrations.
↪Dimension.TagGroup0.Units
 if scale_unit == '\u00b5m':
   scale_unit = 'um'

 dim_x = im.original_metadata.ImageList.TagGroup0.ImageData.Dimensions.Data0
 dim_y = im.original_metadata.ImageList.TagGroup0.ImageData.Dimensions.Data1

 #------------------------
 print('#----------------------')
 print('Filename= {}'.format(filename))
 print('- Date= {}'.format(acq_date))
 print('- Time= {}\n'.format(acq_time))

 print('Microscope= {}'.format(microscope))
 print('- Acquisition Mode= {}'.format(mode_acq))
 print('- Imaging Mode= {}'.format(mode_img))
 print('- Bean energy= {} kV'.format(beam_nrg))
 print('- Exposure Time= {} s\n'.format(exp_time))
 print('- Max Intensity= {} counts'.format(intensity_max))
 print('- Min Intensity= {} counts'.format(intensity_min))

 print('- Magnification= x{:4d}'.format(int(mag)))
 print('- Binning= {}'.format(binning))
 print('- Scale (x,y)= ({:2.4f}, {:2.4f})'.format(scale_x, scale_y))
 print('- Scale Units= {}'.format(scale_unit))
 print('- Dimension (x,y)= ({:4d}, {:4d})'.format(dim_x, dim_y))

 scale_key = 'scale (({:})/px)'.format(scale_unit)

 imgdata = {
   'Filename': filename,
   'Acq.Date': acq_date,
   'Acq.Time': acq_time,
   'Microscope': microscope,
   'Acq.Mode': mode_acq,
```

```
    'Imaging Mode': mode_img,
    'Beam Energy(kV)': beam_nrg,
    'Exposure Time(s)': exp_time,
    'Max Intensity (count)': intensity_max,
    'Min Intensity (count)': intensity_min,
    'Magnification (X)': mag,
    'Binning': binning,
  #  scale_key: (scale_x, scale_y),
    'scale' : (scale_x, scale_y),
    'scale_unit' : scale_unit,
    'dimension (px,px)': (dim_x, dim_y),
    'image size (px,px)': (dim_x, dim_y)    # for dm3 file, no additional area␣
↪is assumed
  }

  return imgdata
```

[11]:
```
# get metadata from tif file, for the case of many empty items.
def getmeta_tif(meta_dict: dict, cat1: str, cat2: str):
  if meta_dict.get(cat1) != None:
    if meta_dict.get(cat1).get(cat2) != None and meta_dict.get(cat1).get(cat2) !
↪= '':
      return meta_dict.get(cat1).get(cat2)
    else:
      return None
  else:
    return None


#  convert metadata as float type, if it is not None
def getmetaf_tif(meta_dict: dict, cat1: str, cat2: str):
  tmpmeta = getmeta_tif(meta_dict, cat1, cat2)
  return np.nan if (tmpmeta == None) else float(tmpmeta)


# extract metadata from SEM tif file
def extmeta_tif(infilename):

  with Image.open(infilename) as img:
    meta = img.tag
    meta_data = meta[34682]
    meta_dim = [meta[256][0], meta[257][0]]

  result = meta_data
  result = meta_data[0].replace('\r', '", ')
  result = result.replace('\n', ' "')
  result = result.replace('=', '" : "')
```

```
result = result.replace(']", ', '" : {')
result = result.replace(',  "",  "[', '}, "')
result = result.replace('[', '"')
result = result.replace(',  "",  "', '}')

if result[-4:] == ',  "':
  result = result[:-4] + '}'

result = '{' + result + '}'
meta_dict = json.loads(result)

filename = infilename.split('/')[-1]

acq_date = getmeta_tif(meta_dict, 'User', 'Date')
acq_time = getmeta_tif(meta_dict, 'User', 'Time')
microscope = getmeta_tif(meta_dict, 'System', 'Type')
mode_acq = getmeta_tif(meta_dict, 'Detectors', 'Mode')
mode_img = getmeta_tif(meta_dict, 'Beam', 'ImageMode')

beam_nrg = getmetaf_tif(meta_dict, 'Beam', 'HV') / 1000
beam_cur_1 = getmeta_tif(meta_dict, 'Beam', 'BeamCurrent')
beam_cur_2 = getmeta_tif(meta_dict, 'EBeam', 'BeamCurrent')
if beam_cur_1 != None:
  beam_cur = float(beam_cur_1) * 1e12
elif beam_cur_2 != None:
  beam_cur = float(beam_cur_2) * 1e12
else:
  beam_cur = None

spot_size = getmetaf_tif(meta_dict, 'Beam', 'Spot')

landing_nrg_1 = getmeta_tif(meta_dict, 'CathodeLens', 'LandingEnergy')
landing_nrg_2 = getmeta_tif(meta_dict, 'EBeamDeceleration', 'LandingEnergy')
if landing_nrg_1 != None:
  landing_nrg = float(landing_nrg_1) / 1000
elif landing_nrg_2 != None:
  landing_nrg = float(landing_nrg_2) / 1000
else:
  landing_nrg = None

dwell_time = getmetaf_tif(meta_dict, 'Scan', 'Dwelltime') * 1e9
frame_time = getmetaf_tif(meta_dict, 'Scan', 'FrameTime')
scale_x = getmetaf_tif(meta_dict, 'Scan', 'PixelWidth') * 1e9
scale_y = getmetaf_tif(meta_dict, 'Scan', 'PixelHeight') * 1e9
scale_unit = 'nm'
scale_key = 'scale (nm/px)'
len_x = getmetaf_tif(meta_dict, 'Scan', 'HorFieldsize') * 1e6
```

```
len_y = getmetaf_tif(meta_dict, 'Scan', 'VerFieldsize') * 1e6
image_avg = getmetaf_tif(meta_dict, 'Image', 'Average')
dim_x = int(getmetaf_tif(meta_dict, 'Image', 'ResolutionX'))
dim_y = int(getmetaf_tif(meta_dict, 'Image', 'ResolutionY'))

stage_x = getmetaf_tif(meta_dict, 'Stage', 'StageX') * 1e3
stage_y = getmetaf_tif(meta_dict, 'Stage', 'StageY') * 1e3
stage_z = getmetaf_tif(meta_dict, 'Stage', 'StageZ') * 1e3
stage_r = getmetaf_tif(meta_dict, 'Stage', 'StageR')
stage_ta = getmetaf_tif(meta_dict, 'Stage', 'StageT')
stage_tb = getmetaf_tif(meta_dict, 'Stage', 'StageTb')

stage_tilt = getmetaf_tif(meta_dict, 'Stage', 'SpecTilt')
work_dist = getmetaf_tif(meta_dict, 'Stage', 'WorkingDistance') * 1e3

img_dim = meta_dim

imgdata = {
  'Filename': filename,
  'Acq.Date': acq_date,
  'Acq.Time': acq_time,
  'Microscope': microscope,
  'Acq.Mode': mode_acq,
  'Imaging Mode': mode_img,
  'Beam Energy (kV)': beam_nrg,
  'Beam Current (pA)' : beam_cur,
  'Landing Energy (kV)' : landing_nrg,
  'Spot Size (nm)' : spot_size,
  'Dwell time (ns)':dwell_time,
  'Frame Time (s)': frame_time,
  'Image Average': image_avg,
  'Stage X (mm)': stage_x,
  'Stage Y (mm)': stage_y,
  'Stage Z (mm)': stage_z,
  'Stage Rotation (deg)': stage_r,
  'Stage Tilt-alpha (deg)': stage_ta,
  'Stage Tilt-beta (deg)': stage_tb,
  'Stage Tilt (deg)': stage_tilt,
  'Working Distance (mm)': work_dist,
  'scale' : (scale_x, scale_y),
  'scale_unit' : scale_unit,
  'dimension (um,um)': (len_x, len_y),
  'dimension (px,px)': (dim_x, dim_y),
  'image size (px,px)': (meta_dim[0], meta_dim[1])
}

return imgdata
```

[6]:
```
# extract metadata from .dm3 or .tif file

def extmeta(infilename):

  if infilename[-3:] == 'dm3':
    return extmeta_dm3(infilename)

  elif infilename[-3:] == 'tif' or infilename[-4:] == 'tiff':
    return extmeta_tif(infilename)
```

1.0.4 4. Function : Image Processing

- Here, simple Auto-Contrast Adjustment

[7]:
```
from skimage.io import imsave, imshow, imread
from skimage import exposure
from matplotlib_scalebar.scalebar import ScaleBar
from matplotlib_scalebar.scalebar import SI_LENGTH_RECIPROCAL
from copy import deepcopy

# define scale bar color: black or white
def sb_color(img):
  imga = np.array(img)

  bl = imga.shape
  bl_row = int(bl[0] * 0.9)
  bl_col = int(bl[1] * 0.1)

  bl_box = imga[bl_row:, :bl_col]
  bl_box_mean = bl_box.mean()

  if bl_box_mean < 128:
    return 'w'
  else:
    return 'k'


# add scale on image
def addscale(img, imgdata, outfile, scale_value='auto'):    # Add Scalebar on␣
 ↪TEM  Image

  # extract scale bar and scale unit
  scale_x = imgdata['scale'][0]
  scale_y = imgdata['scale'][1]
  scale_ratio = scale_y/scale_x
  scale_unit = imgdata['scale_unit']
```

```
  dimension = imgdata['dimension (px,px)']

  # image prepration for new image
  imga = np.array(img)
  color = sb_color(imga)    # color of scale bar
  dpi = 1000

  fig = plt.figure(figsize=(dimension[0]/dpi, dimension[1]/dpi), frameon=False)
  ax = fig.add_axes([0, 0, 1, 1])
  ax.axis('off')
  location = 'lower left'
  frameon = False

  # find optimum scale bar value
  scvs = np.array([1, 2, 5, 10, 20, 50, 100, 200, 500])    # scale bar candidates
  scvs_px = scvs / imgdata['scale'][0]
  rel_len = imgdata['image size (px,px)'][1] *0.2     # scale bar should close␣
↪to 20% of image width
  scale_value = scvs[np.argmin(abs(scvs_px - rel_len))]
  print('scale_value= {}'.format(scale_value))

  if scale_unit[0] == '1':    # reciporcal space, such as 1/nm
    scalebar = ScaleBar(scale_x, scale_unit, SI_LENGTH_RECIPROCAL,
                        location=location,
                        frameon=frameon,
                        color=color,
                        fixed_value=scale_value
                       )
  else:        # real space
    scalebar = ScaleBar(scale_x, scale_unit,
                        location=location,
                        frameon=frameon,
                        color=color,
                        fixed_value=scale_value
                       )

  plt.imshow(imga)
  plt.gca().add_artist(scalebar)
  plt.savefig(outfile, dpi=dpi)

  return outfile


# Image Processing and Add Scalebar
def imgproc(infilename, imgdata):

  outdir = pwd + '/output.dir/' + infilename.split('/')[-2]
```

```
 outfile = pwd + '/output.dir/' + infilename.split('/')[0] + '/' +␣
↪imgdata['Filename'][:-4] + '.jpg'
 outfile_sb = pwd + '/output.dir/' + infilename.split('/')[0] + '/' +␣
↪imgdata['Filename'][:-4] + '_sb.jpg'

 # load image as numpy 2D array
 if infilename[-3:] == 'dm3':
   im = hs.load(infilename)
   img = im.data

 elif infilename[-4:] == 'tiff' or infilename[-3:] == 'tif':
   img = imread(infilename)

   if isinstance(img[0][0], list):   # for the case of RGB image,
     img = img[:, :, 0]                      # pick only R channel

 # if additional area is added on image, crop that out
 slice_flag= 0
 if (infilename[-4:] == 'tiff' or infilename[-3:] == 'tif') and (imgdata['image␣
↪size (px,px)'] != imgdata['dimension (px,px)']):
   slice_flag = 1
   img_main = img[: imgdata['dimension (px,px)'][1], : imgdata['dimension␣
↪(px,px)'][0]]
   img_sub = img[imgdata['dimension (px,px)'][1] : ,  : imgdata['dimension␣
↪(px,px)'][0]]
   img = copy.deepcopy(img_main)

 # Auto contrast
 v_min, v_max = np.percentile(img, (0.2, 99.8))
 img = exposure.rescale_intensity(img, in_range=(v_min, v_max), out_range=(0,␣
↪255)).astype(np.uint8)
 if slice_flag == 1:
   img_sub = exposure.rescale_intensity(img_sub, out_range=(0, 255)).astype(np.
↪uint8)

 # if splitted, restore
 if slice_flag == 1:
   img_sb = np.vstack((img, img_sub))
 else:
   img_sb = copy.deepcopy(img)

 if not os.path.exists(outdir):
   os.mkdir(outdir)

 print('# Outfile = {}'.format(outfile))
```

```
  imsave(outfile, img)
  imsave(outfile_sb, img_sb)

  if slice_flag != 1:
      outfile_sb = addscale(img, imgdata, outfile_sb, scale_value='auto')

  return outfile, outfile_sb
```

1.0.5 5. Function : Add Metadata and Export Image

- Edit metadata on .jpg file

[8]:
```
from PIL import Image
import json
import piexif
import piexif.helper

def addmeta(infilename, imgdata):
  if infilename != None:
    # Load image to edit
    imPIL = Image.open(infilename)

    # For unknown reason, this line prevents strange image shift
    imPIL.save(infilename)
    imgdump = json.dumps(imgdata)
    user_comment = piexif.helper.UserComment.dump(imgdump)

    # extract Exif data from image
    exif_dict = piexif.load(infilename)
    exif_dict["Exif"][piexif.ExifIFD.UserComment] = user_comment
    exif_bytes = piexif.dump(exif_dict)
    piexif.insert(exif_bytes, infilename)
    #print(exif_bytes)

    imPIL.save(infilename, exif=exif_bytes)
    plt.imshow(np.asarray(imPIL));
    plt.close()
```

1.0.6 7. Run on all .dm3 and .tif files

[12]:
```
# load .dm3 image

# directories containing dm3 and tif files
dirs = [file for file in os.listdir(pwd) ]
imgdir = []
```

```
for dirname in dirs:
  if '.' not in dirname:
    imgdir.append(dirname)

for d in imgdir:
  # dm3 and tif files
  print('### directory= {}'.format(d))
  files = [file for file in os.listdir(d) ]
  imgfiles = [file for file in files if (file.endswith('.dm3') or file.
 ↪endswith('.tiff') or file.endswith('tif'))]

  for f in imgfiles:
    print('### file= {}'.format(f))

    # Main part
    infilename = os.path.join(d,f)    # 1. define file name with directory
    imgdata = extmeta(infilename)    # 2. extract meta data
    outfilename, outfilename_sb = imgproc(infilename, imgdata)    # 3. Image␣
 ↪Processing (Auto Contrast, add Scale bar)
    addmeta(outfilename, imgdata)    # 4-1. Add meta data on image only
    addmeta(outfilename_sb, imgdata)    # 4-2. Add meta data on image with scale␣
 ↪bar
```

```
### directory= JehyunTEM
### file= 20110124-TR109-CS_02-DF01d.dm3
#----------------------
Filename= 20110124-TR109-CS_02-DF01d.dm3
- Date= 24.01.2011
- Time= 15:29:42

Microscope= FegTEM
- Acquisition Mode= TEM
- Imaging Mode= IMAGING
- Bean energy= 200.0 kV
- Exposure Time= 5.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= 0.0 counts
- Magnification= x43000
- Binning= (1, 1)
- Scale (x,y)= (0.1521, 0.1521)
- Scale Units= nm
- Dimension (x,y)= (2688, 2672)
###### infilename JehyunTEM/20110124-TR109-CS_02-DF01d.dm3
###### Filename 20110124-TR109-CS_02-DF01d.dm3
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
```

```
 /190618_ImageMetadata/output.dir/JehyunTEM/20110124-TR109-CS_02-DF01d.jpg
scale_value= 100
### file= 20110329-TR118-PV_01-BF01.dm3
#----------------------
Filename= 20110329-TR118-PV_01-BF01.dm3
- Date= 29.03.2011
- Time= 10:23:47

Microscope= []
- Acquisition Mode= TEM
- Imaging Mode= IMAGING
- Bean energy= 200.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= 0.0 counts
- Magnification= x71000
- Binning= (1, 1)
- Scale (x,y)= (0.1045, 0.1045)
- Scale Units= nm
- Dimension (x,y)= (2688, 2672)
###### infilename JehyunTEM/20110329-TR118-PV_01-BF01.dm3
###### Filename 20110329-TR118-PV_01-BF01.dm3
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/JehyunTEM/20110329-TR118-PV_01-BF01.jpg
scale_value= 50
### file= 20110329-TR118-PV_01-SADP01.dm3
#----------------------
Filename= 20110329-TR118-PV_01-SADP01.dm3
- Date= 29.03.2011
- Time= 10:10:50

Microscope= []
- Acquisition Mode= TEM
- Imaging Mode= DIFFRACTION
- Bean energy= 200.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= 0.0 counts
- Magnification= x 300
- Binning= (2, 2)
- Scale (x,y)= (0.0174, 0.0174)
- Scale Units= 1/nm
- Dimension (x,y)= (1344, 1336)
###### infilename JehyunTEM/20110329-TR118-PV_01-SADP01.dm3
###### Filename 20110329-TR118-PV_01-SADP01.dm3
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
```

```
 /190618_ImageMetadata/output.dir/JehyunTEM/20110329-TR118-PV_01-SADP01.jpg
scale_value= 5

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 1:47:20,  could
not be parsed

### directory= MnS#1
### file= 1000X-0012(MnS alpha).dm3
#----------------------
Filename= 1000X-0012(MnS alpha).dm3
- Date= 2018-12-27
- Time= PM 1:47:20

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= DIFF
- Bean energy= 300.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
- Magnification= x1000
- Binning= (2, 2)
- Scale (x,y)= (0.0120, 0.0120)
- Scale Units= 1/nm
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#1/1000X-0012(MnS alpha).dm3
###### Filename 1000X-0012(MnS alpha).dm3

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 1:47:20,  could
not be parsed

# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#1/1000X-0012(MnS alpha).jpg
scale_value= 5

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 1:49:40,  could
not be parsed
WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 1:49:40,  could
not be parsed

### file= 30000X-0013.dm3
#----------------------
Filename= 30000X-0013.dm3
- Date= 2018-12-27
- Time= PM 1:49:40

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= MAG1
- Bean energy= 300.0 kV
```

```
- Exposure Time= 0.5 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
- Magnification= x30000
- Binning= (2, 2)
- Scale (x,y)= (0.7519, 0.7519)
- Scale Units= nm
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#1/30000X-0013.dm3
###### Filename 30000X-0013.dm3
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#1/30000X-0013.jpg
scale_value= 200

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 3:09:55,  could
not be parsed

### directory= MnS#2
### file= 1000X-0036(maybe MnS alhpha and weak MnS2 1104).dm3
#----------------------
Filename= 1000X-0036(maybe MnS alhpha and weak MnS2 1104).dm3
- Date= 2019-01-03
- Time= PM 3:09:55

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= DIFF
- Bean energy= 300.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
- Magnification= x1000
- Binning= (2, 2)
- Scale (x,y)= (0.0120, 0.0120)
- Scale Units= 1/nm
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#2/1000X-0036(maybe MnS alhpha and weak MnS2 1104).dm3
###### Filename 1000X-0036(maybe MnS alhpha and weak MnS2 1104).dm3

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 3:09:55,  could
not be parsed

# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#2/1000X-0036(maybe MnS alhpha and weak
MnS2 1104).jpg
scale_value= 5

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 3:09:01,  could
```

```
not be parsed

### file= 60000X-0035.dm3
#----------------------
Filename= 60000X-0035.dm3
- Date= 2019-01-03
- Time= PM 3:09:01

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= MAG1
- Bean energy= 300.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
- Magnification= x60000
- Binning= (2, 2)
- Scale (x,y)= (0.3706, 0.3706)
- Scale Units= nm
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#2/60000X-0035.dm3
###### Filename 60000X-0035.dm3

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 3:09:01,  could
not be parsed

# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#2/60000X-0035.jpg
scale_value= 100

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:23:14,  could
not be parsed

### directory= MnS#4
### file= 10000X-0007(MnS-alpha).dm3
#----------------------
Filename= 10000X-0007(MnS-alpha).dm3
- Date= 2019-01-10
- Time= PM 10:23:14

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= MAG1
- Bean energy= 300.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
- Magnification= x10000
```

```
- Binning= (2, 2)
- Scale (x,y)= (0.0023, 0.0023)
- Scale Units= um
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#4/10000X-0007(MnS-alpha).dm3
###### Filename 10000X-0007(MnS-alpha).dm3

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:23:14,  could
not be parsed

# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#4/10000X-0007(MnS-alpha).jpg
scale_value= 1

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:10:09,  could
not be parsed

### file= 1000X-0004(maybe MnS-alpha).dm3
#----------------------
Filename= 1000X-0004(maybe MnS-alpha).dm3
- Date= 2019-01-10
- Time= PM 10:10:09

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= DIFF
- Bean energy= 300.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
- Magnification= x1000
- Binning= (2, 2)
- Scale (x,y)= (0.0120, 0.0120)
- Scale Units= 1/nm
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#4/1000X-0004(maybe MnS-alpha).dm3
###### Filename 1000X-0004(maybe MnS-alpha).dm3

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:10:09,  could
not be parsed

# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#4/1000X-0004(maybe MnS-alpha).jpg
scale_value= 5
### file= 1000X-0005(MnS-alpha).dm3

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:16:56,  could
not be parsed
WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:16:56,  could
not be parsed
```

```
#----------------------
Filename= 1000X-0005(MnS-alpha).dm3
- Date= 2019-01-10
- Time= PM 10:16:56

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= DIFF
- Bean energy= 300.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
- Magnification= x1000
- Binning= (2, 2)
- Scale (x,y)= (0.0120, 0.0120)
- Scale Units= 1/nm
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#4/1000X-0005(MnS-alpha).dm3
###### Filename 1000X-0005(MnS-alpha).dm3
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#4/1000X-0005(MnS-alpha).jpg
scale_value= 5

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:30:27,  could
not be parsed

### file= 1000X-0012(MnS-alpha).dm3
#----------------------
Filename= 1000X-0012(MnS-alpha).dm3
- Date= 2019-01-10
- Time= PM 10:30:27

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= DIFF
- Bean energy= 300.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
- Magnification= x1000
- Binning= (2, 2)
- Scale (x,y)= (0.0120, 0.0120)
- Scale Units= 1/nm
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#4/1000X-0012(MnS-alpha).dm3
###### Filename 1000X-0012(MnS-alpha).dm3
```

```
WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:30:27,  could
not be parsed

# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#4/1000X-0012(MnS-alpha).jpg
scale_value= 5

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:31:10,  could
not be parsed

### file= 25000X-0011(MnS-alpha).dm3
#----------------------
Filename= 25000X-0011(MnS-alpha).dm3
- Date= 2019-01-10
- Time= PM 10:31:10

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= MAG1
- Bean energy= 300.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
- Magnification= x25000
- Binning= (2, 2)
- Scale (x,y)= (0.9076, 0.9076)
- Scale Units= nm
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#4/25000X-0011(MnS-alpha).dm3
###### Filename 25000X-0011(MnS-alpha).dm3

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:31:10,  could
not be parsed

# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#4/25000X-0011(MnS-alpha).jpg
scale_value= 500

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:33:49,  could
not be parsed

### file= 25000X-0013(MnS-alpha).dm3
#----------------------
Filename= 25000X-0013(MnS-alpha).dm3
- Date= 2019-01-10
- Time= PM 10:33:49

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= MAG1
```

```
- Bean energy= 300.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
- Magnification= x25000
- Binning= (2, 2)
- Scale (x,y)= (0.9076, 0.9076)
- Scale Units= nm
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#4/25000X-0013(MnS-alpha).dm3
###### Filename 25000X-0013(MnS-alpha).dm3

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:33:49,  could
not be parsed

# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#4/25000X-0013(MnS-alpha).jpg
scale_value= 500

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:07:17,  could
not be parsed

### file= 30000X-0003(maybe MnS-alpha).dm3
#----------------------
Filename= 30000X-0003(maybe MnS-alpha).dm3
- Date= 2019-01-10
- Time= PM 10:07:17

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= MAG1
- Bean energy= 300.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
- Magnification= x30000
- Binning= (2, 2)
- Scale (x,y)= (0.7519, 0.7519)
- Scale Units= nm
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#4/30000X-0003(maybe MnS-alpha).dm3
###### Filename 30000X-0003(maybe MnS-alpha).dm3

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:07:17,  could
not be parsed

# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#4/30000X-0003(maybe MnS-alpha).jpg
scale_value= 200
```

```
WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:27:06,  could
not be parsed

### file= 6000X-0010(MnS-alpha).dm3
#----------------------
Filename= 6000X-0010(MnS-alpha).dm3
- Date= 2019-01-10
- Time= PM 10:27:06

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= MAG1
- Bean energy= 300.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
- Magnification= x6000
- Binning= (2, 2)
- Scale (x,y)= (0.0038, 0.0038)
- Scale Units= um
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#4/6000X-0010(MnS-alpha).dm3
###### Filename 6000X-0010(MnS-alpha).dm3

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 10:27:06,  could
not be parsed

# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#4/6000X-0010(MnS-alpha).jpg
scale_value= 2

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 2:26:50,  could
not be parsed

### directory= MnS#5
### file= 1000X-0008.dm3
#----------------------
Filename= 1000X-0008.dm3
- Date= 2019-01-16
- Time= PM 2:26:50

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= DIFF
- Bean energy= 300.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
```

```
- Magnification= x1000
- Binning= (2, 2)
- Scale (x,y)= (0.0120, 0.0120)
- Scale Units= 1/nm
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#5/1000X-0008.dm3
###### Filename 1000X-0008.dm3

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 2:26:50,  could
not be parsed

# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#5/1000X-0008.jpg
scale_value= 5

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 2:27:33,  could
not be parsed

### file= 30000X-0009.dm3
#----------------------
Filename= 30000X-0009.dm3
- Date= 2019-01-16
- Time= PM 2:27:33

Microscope= JEM 3010
- Acquisition Mode= TEM
- Imaging Mode= MAG1
- Bean energy= 300.0 kV
- Exposure Time= 1.0 s

- Max Intensity= 16383.0 counts
- Min Intensity= -99.0 counts
- Magnification= x30000
- Binning= (2, 2)
- Scale (x,y)= (0.7519, 0.7519)
- Scale Units= nm
- Dimension (x,y)= (2000, 2000)
###### infilename MnS#5/30000X-0009.dm3
###### Filename 30000X-0009.dm3

WARNING:hyperspy.io_plugins.digital_micrograph:Time string, PM 2:27:33,  could
not be parsed

# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/MnS#5/30000X-0009.jpg
scale_value= 200
### directory= SEM
### file= 1-1k_005.tif
###### infilename SEM/1-1k_005.tif
###### Filename 1-1k_005.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
```

```
 /190618_ImageMetadata/output.dir/SEM/1-1k_005.jpg
### file= 1-2500_014.tif
###### infilename SEM/1-2500_014.tif
###### Filename 1-2500_014.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/1-2500_014.jpg
### file= 1-2k_031.tif
###### infilename SEM/1-2k_031.tif
###### Filename 1-2k_031.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/1-2k_031.jpg
### file= 1-500_002.tif
###### infilename SEM/1-500_002.tif
###### Filename 1-500_002.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/1-500_002.jpg
### file= 1-50k.tif
###### infilename SEM/1-50k.tif
###### Filename 1-50k.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/1-50k.jpg
### file= 1_1.tif
###### infilename SEM/1_1.tif
###### Filename 1_1.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/1_1.jpg
### file= 1_2.tif
###### infilename SEM/1_2.tif
###### Filename 1_2.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/1_2.jpg
### file= 1_3.tif
###### infilename SEM/1_3.tif
###### Filename 1_3.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/1_3.jpg
### file= 1_8.tif
###### infilename SEM/1_8.tif
###### Filename 1_8.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/1_8.jpg
### file= 2-20k_035.tif
###### infilename SEM/2-20k_035.tif
###### Filename 2-20k_035.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/2-20k_035.jpg
### file= 3-250_018.tif
###### infilename SEM/3-250_018.tif
```

```
###### Filename 3-250_018.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/3-250_018.jpg
### file= 3_3.tif
###### infilename SEM/3_3.tif
###### Filename 3_3.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/3_3.jpg
### file= 3_4.tif
###### infilename SEM/3_4.tif
###### Filename 3_4.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/3_4.jpg
### file= 3_5.tif
###### infilename SEM/3_5.tif
###### Filename 3_5.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/3_5.jpg
### file= 4_3.tif
###### infilename SEM/4_3.tif
###### Filename 4_3.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/4_3.jpg
### file= 4_4.tif
###### infilename SEM/4_4.tif
###### Filename 4_4.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/4_4.jpg
### file= 4_6.tif
###### infilename SEM/4_6.tif
###### Filename 4_6.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/4_6.jpg
### file= Mus.-5k_024.tif
###### infilename SEM/Mus.-5k_024.tif
###### Filename Mus.-5k_024.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/Mus.-5k_024.jpg
### file= Mus.-800_019.tif
###### infilename SEM/Mus.-800_019.tif
###### Filename Mus.-800_019.tif
# Outfile = /workplace/01_KIER_Computational/04_Projects/2018_
 /190618_ImageMetadata/output.dir/SEM/Mus.-800_019.jpg
```

[ ]: