```
function saveStateGif(t,Ri,Cib,filepath,name,varargin)
%{
This function creates an animated gif of Manny and saves it to a file.
Using default settings, the gif will need about 1 second of render time per
one second of simulated time. Adjusting the settings from default can
reduce or improve this time, the most influential factor being the
framerate.

INPUTS
t - [Nx1] time vector (s)
Ri - [Nx3] inertial position vector (m)
Cib - [3x3xN] vector of rotation matrices from the body to inertial frame
filepath - [string] path where the output media will be saved
name - [string] name assigned to the output media

%}
%parse optional kwargs
p = inputParser;

%optional inputs
addParameter(p,'Margin',1) %sets spacing around the center of Manny
addParameter(p,'View',3) %controls the direction of the observer
addParameter(p,'DynamicCameraMotion',1) %controls whether the camera tracks
Manny
addParameter(p,'MakeGif',0)
addParameter(p,'MakeVideo',1)
addParameter(p,'OpenFolder',1)

%parse
parse(p,varargin{:});

%name the variables more sensible things
Margin = p.Results.Margin;
View = p.Results.View;
DynamicCameraMotion = p.Results.DynamicCameraMotion;
MakeGif = p.Results.MakeGif;
MakeVideo = p.Results.MakeVideo;
OpenFolder = p.Results.OpenFolder;

%start a timer
tic

%enforce Ri [3xN] for later manipulation
Ri = enforceTallSkinny(Ri)';

fprintf("Creating media.\n");

%precompute axis bounds
if(DynamicCameraMotion)
    bound_matrix = [-Margin+Ri(1,:);Margin+Ri(1,:);-
Margin+Ri(2,:);Margin+Ri(2,:);...
        -Margin+Ri(3,:);Margin+Ri(3,:)];
```

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end

% Make sure file paths are available to this function
if(~exist("project_path_list","var"))
    project_path_list = getProjectPaths();
end

%identify sensible data bounds based on how far the robot moves
%lower_bound = floor(min([min(Ri(:,1)),min(Ri(:,2)),min(Ri(:,3))]));
%upper_bound = ceil(max([max(Ri(:,1)),max(Ri(:,2)),max(Ri(:,3))]));

%set up the figure
f = figure('Visible','off','Position',[400 2400 1200 800]);ax =
axes('Parent',f);
axis(ax,'manual')
axis(ax,Margin.*[-1 1 -1 1 -1 1])
view(ax,View)
hold on
xlabel("x")
ylabel("y")
zlabel("z")
title(name)
set(gca,'Zdir','reverse')
set(gca,'Ydir','reverse')

%load the patch data for Manny from where it is stored in the file system
%will be already on path if using project structure correctly
p_struct = load("manny_patch.mat","p");
p = p_struct.p;

% Set up lighting
light('Position',[1 1 1],'Style','infinite');

%identify timestep in data
dt = t(2)-t(1);

%get frames
tObj = hgtransform('Parent',ax);
p.Parent = tObj;

%TODO - Make frameskip a keyword argument
frameskip = 1;
frame_index = 1;

%frames
nFrames = round(length(t)/frameskip);
frameArray = cell(1,nFrames);  % store frames

%Start printout percentage
percent_text = fprintf("Media is 0.00%% Complete");

for k = 1:frameskip:length(t)
    %get rotation and position at timestep k
    Cibk = Cib(:,:,k);
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    Rik = Ri(:,k);

    %build transform matrix
    T = eye(4);
    T(1:3,1:3) = Cibk;
    T(1:3,4) = Rik;
    tObj.Matrix = T;

    %draw plot and save the frame
    drawnow limitrate;
    frameArray{frame_index} = getframe(f);
    frame_index = frame_index + 1;

    %update axis to track Manny's position
    if(DynamicCameraMotion)
        axis(ax,bound_matrix(:,k))
    end

    %print progress to user every 10 frames
    if(mod(frame_index,10)==0)
        percent_complete = frame_index/nFrames*100;

        fprintf(repmat('\b',1,percent_text));
        percent_text = fprintf("Gif is %.2f%% Complete\n",percent_complete);
    end
end

close(f);


if(MakeVideo)
    video_path = fullfile(filepath,name + ".avi");
    v = VideoWriter(video_path,'Motion JPEG AVI');
    v.FrameRate = 1/dt;
    open(v);

    for k = 1:nFrames
        writeVideo(v,frameArray{k});
    end

    close(v);
end


if(MakeGif)
    %define the path for the gif
    gif_path = fullfile(filepath,name+".gif");
    for k = 1:nFrames
        %convert each frame to grayscale for speed
        grayFrame = rgb2gray(frameArray{k}.cdata);
        %convert each frame to a 256x256 indexed image "A" with colormap
"map"
        [A,map] = gray2ind(grayFrame,256);
        %append the image to the gif
```

```
        if k == 1

imwrite(A,map,gif_path,'gif','LoopCount',inf,'DelayTime',frameskip*dt);
        else

imwrite(A,map,gif_path,'gif','WriteMode','append','DelayTime',frameskip*dt);
        end
    end

end

%Overwrite prior text line with new one to avoid annoying scrolling
fprintf(repmat('\b',1,percent_text));
fprintf("Gif is 100.0%% Complete\n");
t1 = toc;
fprintf("Time elapsed: %.2f seconds.\n",t1)

%Open the file location of the gif if the user chooses
if(OpenFolder)
    try
        winopen(filepath);
    catch
        fprintf("Failed to open the gif folder.\nThis feature only works on
windows right now ):")
    end

end
```

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