\documentclass[12pt]{article}

\usepackage[utf8]{inputenc}

\usepackage{latexsym}

\usepackage{float}

\usepackage{parskip}

\usepackage{amsfonts}

\usepackage{caption}

\usepackage{commath}

\usepackage{amssymb,amsmath}

\usepackage{graphicx}

\usepackage{multirow}

\usepackage{pifont}

\usepackage[backend=bibtex,style=numeric,sorting=none]{biblatex}

\usepackage[export]{adjustbox}

\usepackage{subcaption}

\usepackage[top=1in, bottom=1in,left=1in, right=1in]{geometry}

\usepackage{minted}

\usepackage{color}

\newcommand{\tb}{\textcolor{blue}}

\newcommand{\tc}{\textcolor{red}}

\newcommand{\bs}{\boldsymbol}

\newenvironment{alphafootnotes}

{\par\edef\savedfootnotenumber{\number\value{footnote}}

\renewcommand{\thefootnote}{\alph{footnote}}

\setcounter{footnote}{0}}

{\par\setcounter{footnote}{\savedfootnotenumber}}

\begin{document}

\title{Work Report 08.09.2017}

\author{Xin (Keira) Shu, Yili Yang}

\date{August 2017}

\maketitle

\section{Curvature Plots for a Random Mitigation Vector}

This time we would like to investigate the curvatures for points other than the optimal one. In this case, we fix an arbitrary point, a $63\times1$ vector, whose entries are randomly picked from (0,1]. Like what we did for the optimal point, we do mitigation changes of size 0.02 in 1 and 2 dimensions and generate the plots for utilities.

When we do 1-dimensional change, the plots typically look like the 2 shapes below. What we see in Figure \ref{32} is more like a straight line.

\begin{figure}[H]

\caption{Utilities with 1-dimension Mitigation Change}

\begin{subfigure}{0.5\textwidth}

\includegraphics[width=0.9\linewidth, height=5cm]{5}

\caption{Node 5}

\label{5}

\end{subfigure}

\begin{subfigure}{0.5\textwidth}

\includegraphics[width=0.9\linewidth, height=5cm]{32}

\caption{Node 32}

\label{32}

\end{subfigure}

\end{figure}

We get some convex curves, but we also observe a few concave ones. See Figure \ref{59} and \ref{9}.

\begin{figure}[H]

\caption{Utilities with 1-dimension Mitigation Change}

\begin{subfigure}{0.5\textwidth}

\includegraphics[width=0.9\linewidth, height=5cm]{59}

\caption{Node 59}

\label{59}

\end{subfigure}

\begin{subfigure}{0.5\textwidth}

\includegraphics[width=0.9\linewidth, height=5cm]{9}

\caption{Node 9}

\label{9}

\end{subfigure}

\end{figure}

When it comes to the 2-dimensional changes, the resulted figures also look quite different from those at the optimal point. Most of the plots have a flat plane like Figure \ref{8\_63} below.

\begin{figure}[H]

\caption{Utilities with 2-dimension Mitigation Change}

\includegraphics[scale=0.8]{8\_63}

\label{8\_63}

\end{figure}

There are more typical shapes that we can take a look at.

\begin{figure}[H]

\caption{Utilities with 1-dimension Mitigation Change}

\begin{subfigure}{0.5\textwidth}

\includegraphics[width=0.9\linewidth, height=5cm]{13\_15}

\caption{Node 13 and 15}

\label{13\_15}

\end{subfigure}

\begin{subfigure}{0.5\textwidth}

\includegraphics[width=0.9\linewidth, height=5cm]{27\_29}

\caption{Node 27 and 29}

\label{27\_29}

\end{subfigure}

\\

\begin{subfigure}{0.5\textwidth}

\includegraphics[width=0.9\linewidth, height=5cm]{52\_57}

\caption{Node 52 and 57}

\label{52\_57}

\end{subfigure}

\begin{subfigure}{0.5\textwidth}

\includegraphics[width=0.9\linewidth, height=5cm]{5\_19}

\caption{Node 5 and 19}

\label{5\_19}

\end{subfigure}

\end{figure}

\section{Plots for Norm of Gradients During Optimization}

We draw graphs of the number of function (utility and gradient) evaluations v.s. norm of gradient to see whether the algorithm struggles far from the solution or in the neighbourhood of the solution.

\begin{center}

\captionof{table}{Iteration and Function Evaluation for Each Test}

\begin{tabular}{||c c c c c c||}

\hline

ID of test & 1 & 2& 3&4 &5 \\

\hline

Number of iterations & 249&218&263&247&212 \\

\hline

Number of Function Evaluation & 615 &594 &288&670&557\\

\hline

\end{tabular}

\label{pd-optimal}

\end{center}

\begin{figure}[H]

\includegraphics[width=0.8\linewidth, height=8cm]{1.png}

\caption{test1}

\label{test1}

\end{figure}

\begin{figure}[H]

\includegraphics[width=0.8\linewidth, height=8cm]{2.png}

\caption{test2}

\label{test2}

\end{figure}

\begin{figure}[H]

\includegraphics[width=0.8\linewidth, height=8cm]{3.png}

\caption{test3}

\label{test3}

\end{figure}

\begin{figure}[H]

\includegraphics[width=0.8\linewidth, height=8cm]{4.png}

\caption{test4}

\label{test4}

\end{figure}

\begin{figure}[H]

\includegraphics[width=0.8\linewidth, height=8cm]{5.png}

\caption{test5}

\label{test5}

\end{figure}

Raw data are attached at the end of the report.

\end{document}