

# Multimodal MATLAB: data visualization for the blind

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## motivation

- data visualization tools have revolutionized fields of Science, Mathematics, Engineering, Medicine
- graphical representations provide powerful aids to discovery, innovation, teaching
- unfortunately graphs/visualizations are largely inaccessible to people with severe visual impairments
- goal is to develop tools for creating multimodal data representations that are accessible to everyone

## MATLAB

- widely used technical computing environment
- open source “toolboxes”
- powerful graphing/visualization functions
  - 2d/3d/volumetric graphics, animation, image processing, ...
- **pcolor** function
  - 2d matrix plot, data values mapped to color scale
  - color scales set by **colormap** function

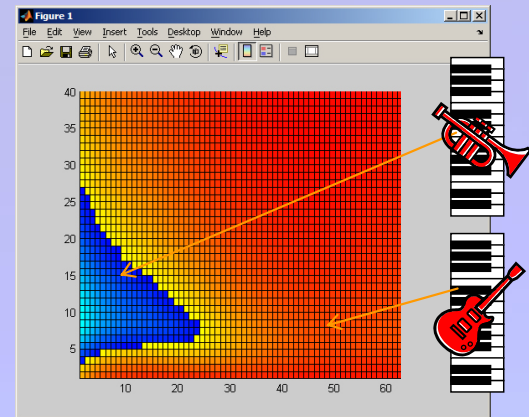
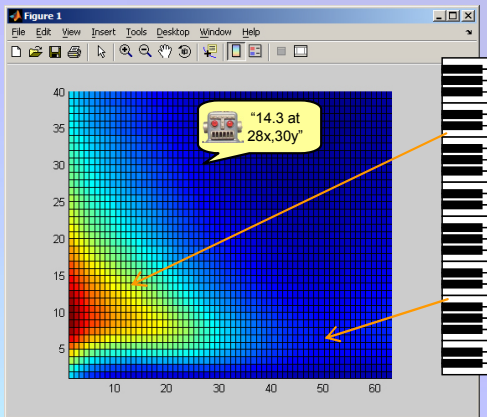
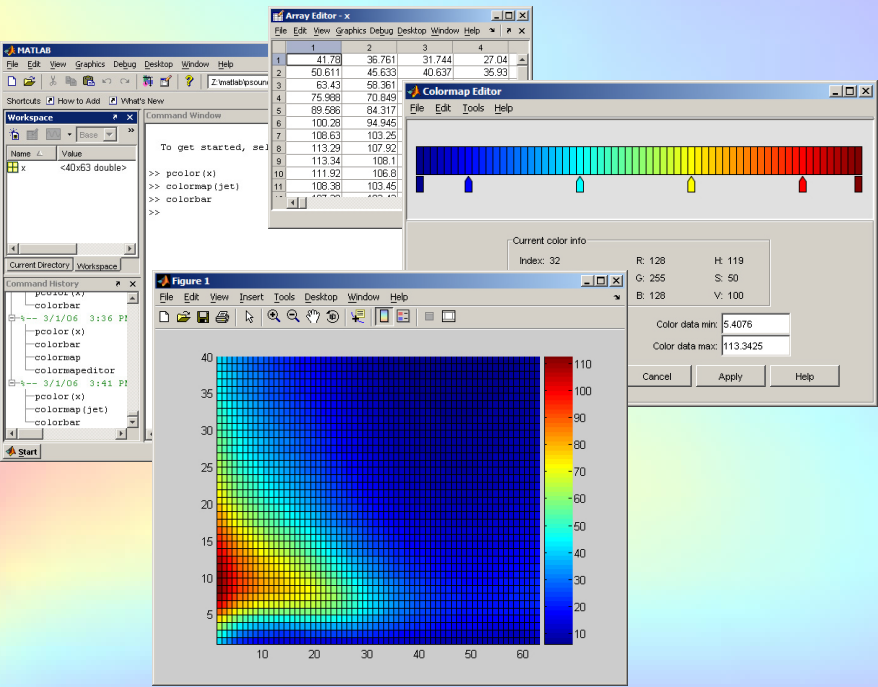
**Abstract:** Data visualization methods have revolutionized the fields of Science, Mathematics, Engineering and Medicine. The ability to create, view, and interact with meaningful visual representations of complex multidimensional datasets has been a powerful aid to discovery, innovation, and teaching in all these fields. Unfortunately the graphical tools that have been of such benefit to these communities are largely inaccessible to its blind and visually impaired members. To address this issue we have developed a new set of data “visualization” tools for people with visual disabilities. The tools extend the graphics capabilities of MATLAB, the widely-used open-source technical computing environment. We call the tools MIST (for Matlab Interactive Sonification Toolbox). MIST supports the creation of multimodal graphs that include visual, auditory, and synthetic speech components. Users can interact with these multimodal graphs using a mouse, tablet, or keyboard commands. A key innovation is the ability to create multidimensional MIDI “soundmaps” that can be used to represent complex data attributes in sonified form. We are currently evaluating the usability and effectiveness of MIST with both blind and sighted users. We are also extending the toolkit to include tactile data representations and to support novel non-visual interfaces.

## MIST

- **Matlab Interactive Sonification Toolbox**
  - **psound:** produces interactive multimodal 2d graphs
    - visual, auditory, and synthetic speech output
    - mouse, tablet, or keyboard interaction
  - **soundmap:** defines data to sound mappings
    - MIDI (Musical Instrument Digital Interface) protocol
    - PC soundcard synthesizer
    - versatile sonification capabilities

MIDI soundmap			
index	note	instrument	perf. params.
1	A3	guitar	volume
2	B3	guitar	pan L/R
3	F5	trumpet	vibrato
4	G5	trumpet	decay
...	...	...	...

## Examples



## impact:

- data “visualization” tool for the visually impaired
- multimodal output, supports independent data exploration, collaboration with sighted colleagues
- MATLAB platform, open source, extensible
- future work: ecological sound, tactile output, direct interaction