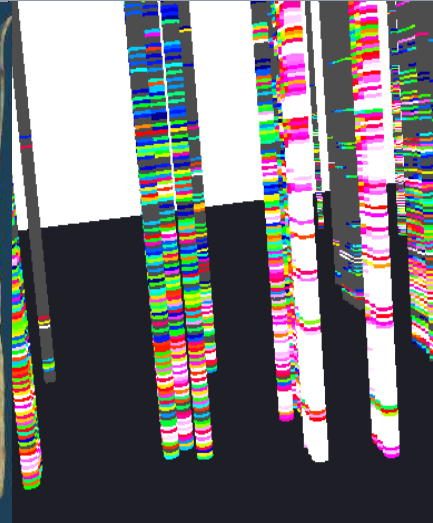
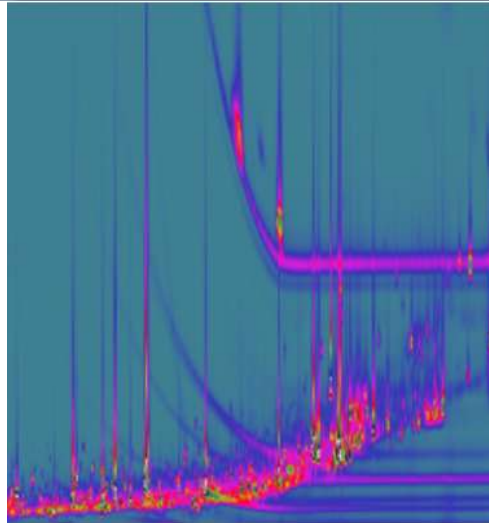
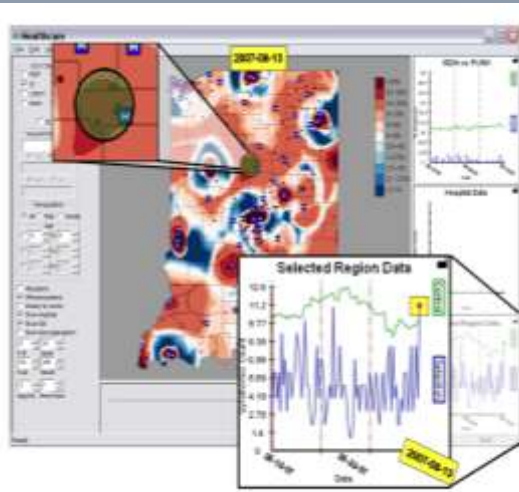


Visual Analytics for Cancer Care Engineering



Wei Chen, David S. Ebert

June 20, 2008

Visual Analytics

The science of analytical reasoning facilitated by interactive visual interfaces.

1

Synthesize
information
and derive
insight

2

Detect the
expected and
discover the
unexpected

3

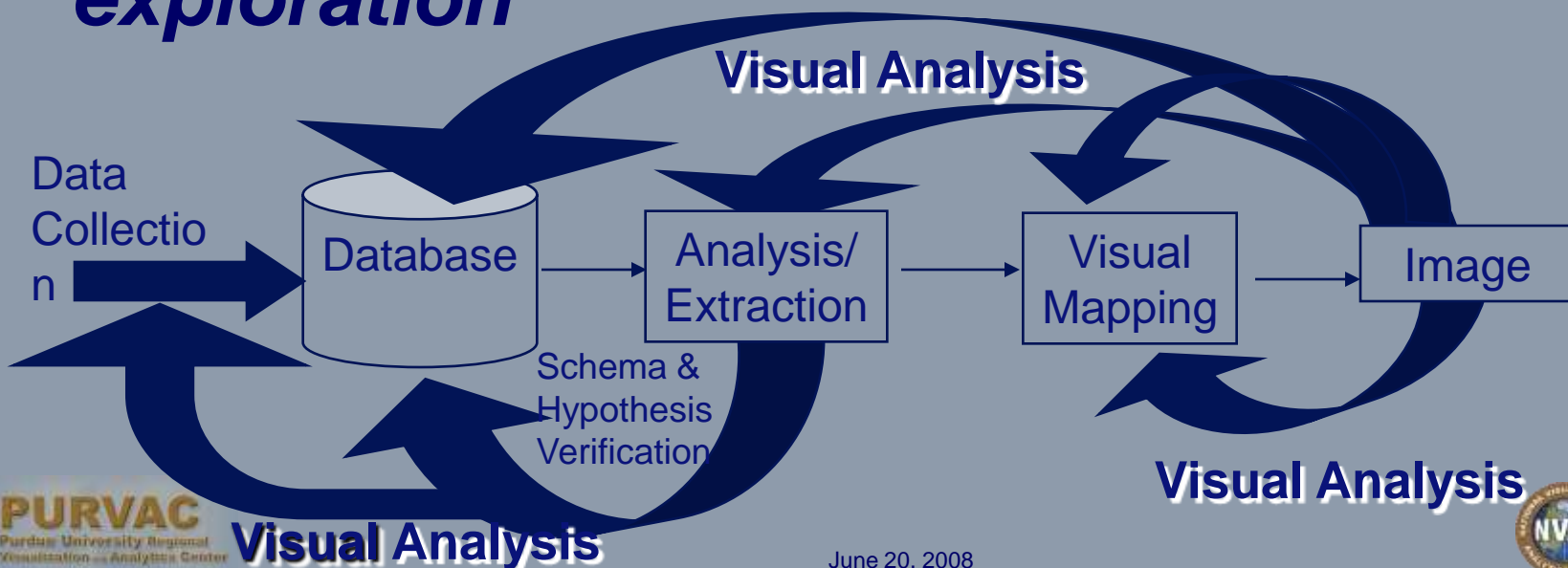
Provide and
communicate
assessments

Visual Analysis Goals

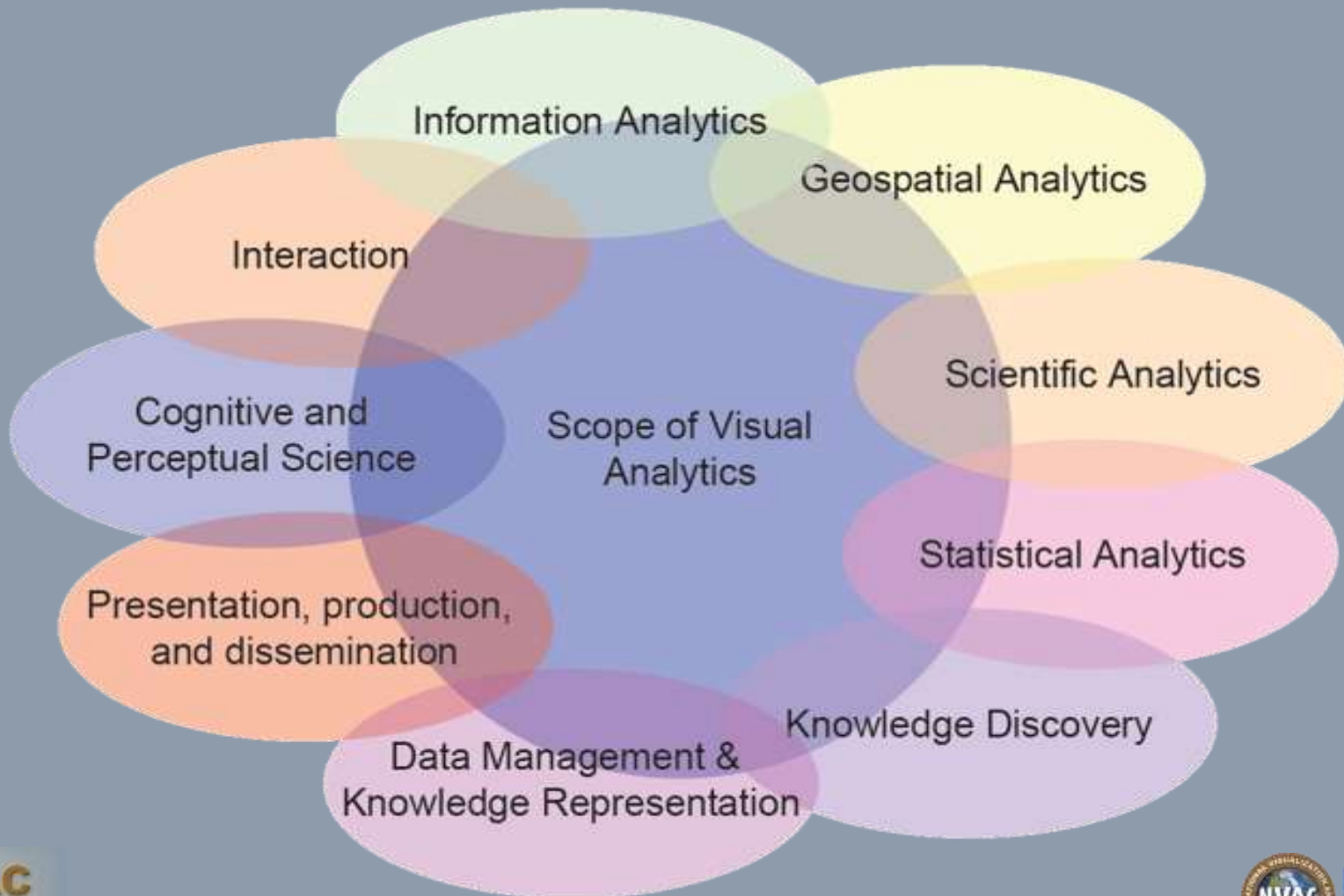
Effectively convey information to the user

Increase the quantity and clarity of the information

Allow interactive visual analysis and exploration



Related Fields of Study



TADA: Technology Assisted Dietary Assessment (Boushey, Ebert, Delp, Lutes)

Goal: Provide nutritional information of food consumed by simply taking a picture of the plate of food before and after the meal using a cellphone

Application: Disease dietary assessment, weight loss

Process:

Image segmentation

volume estimation

Nutritional calculation

TADA Overview



Extract →

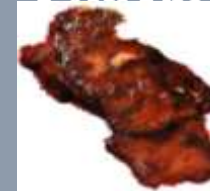
Garlic bread



steak



Pork Rib



Before Meal



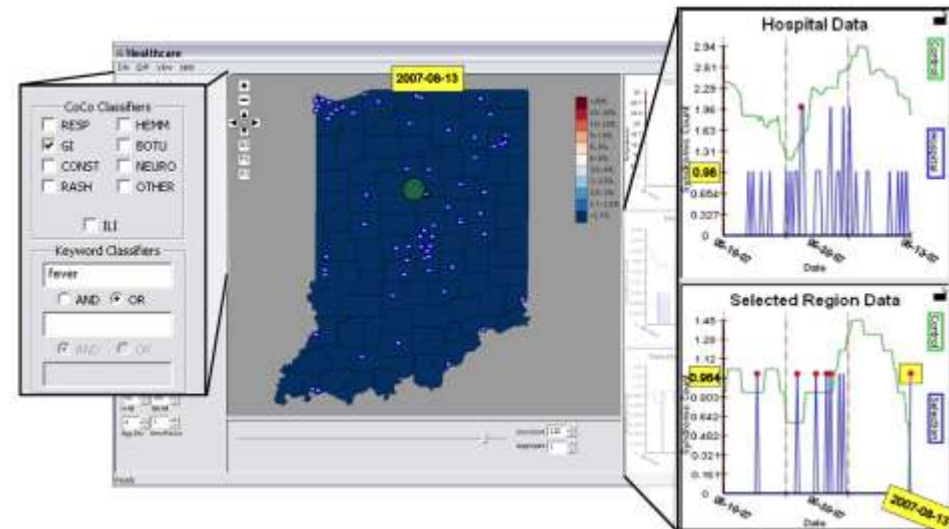
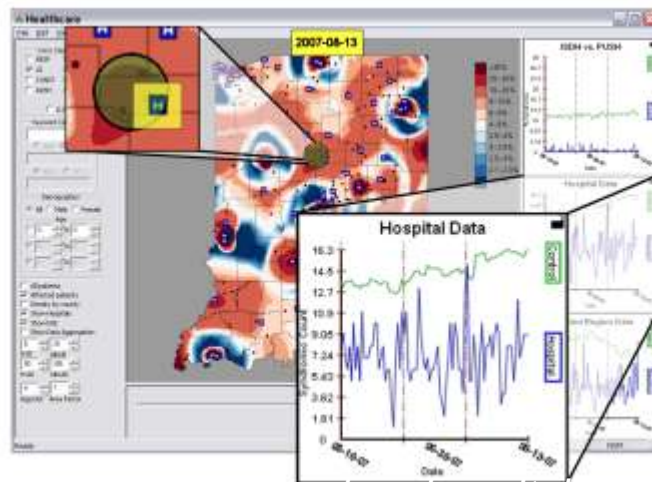
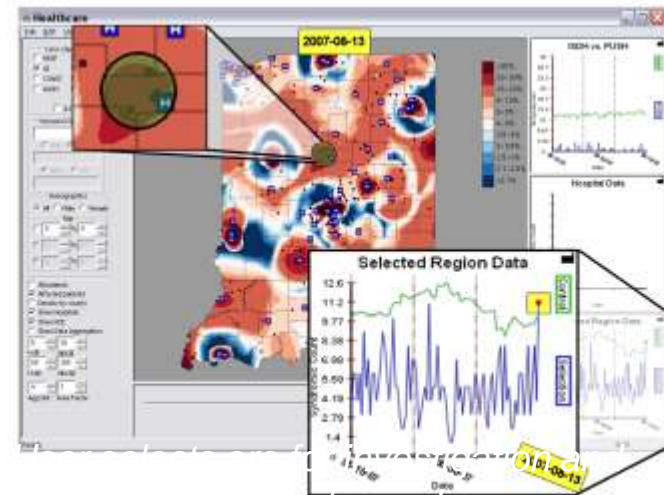
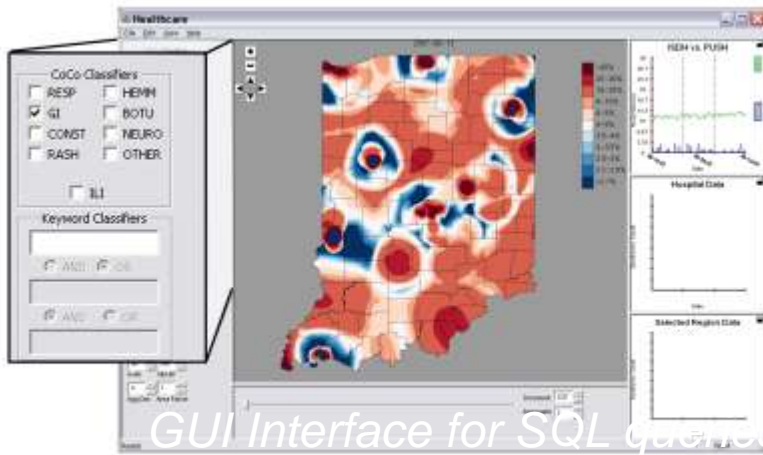
After Meal



Food intake
←→
comparison



Developing an Interactive Visual Analytics Environment – Health Surveillance



Initial Data Sets

Modeling

- Peak identification
- Statistical analysis
- Correlative analysis
- Sample Classification

Patient Information

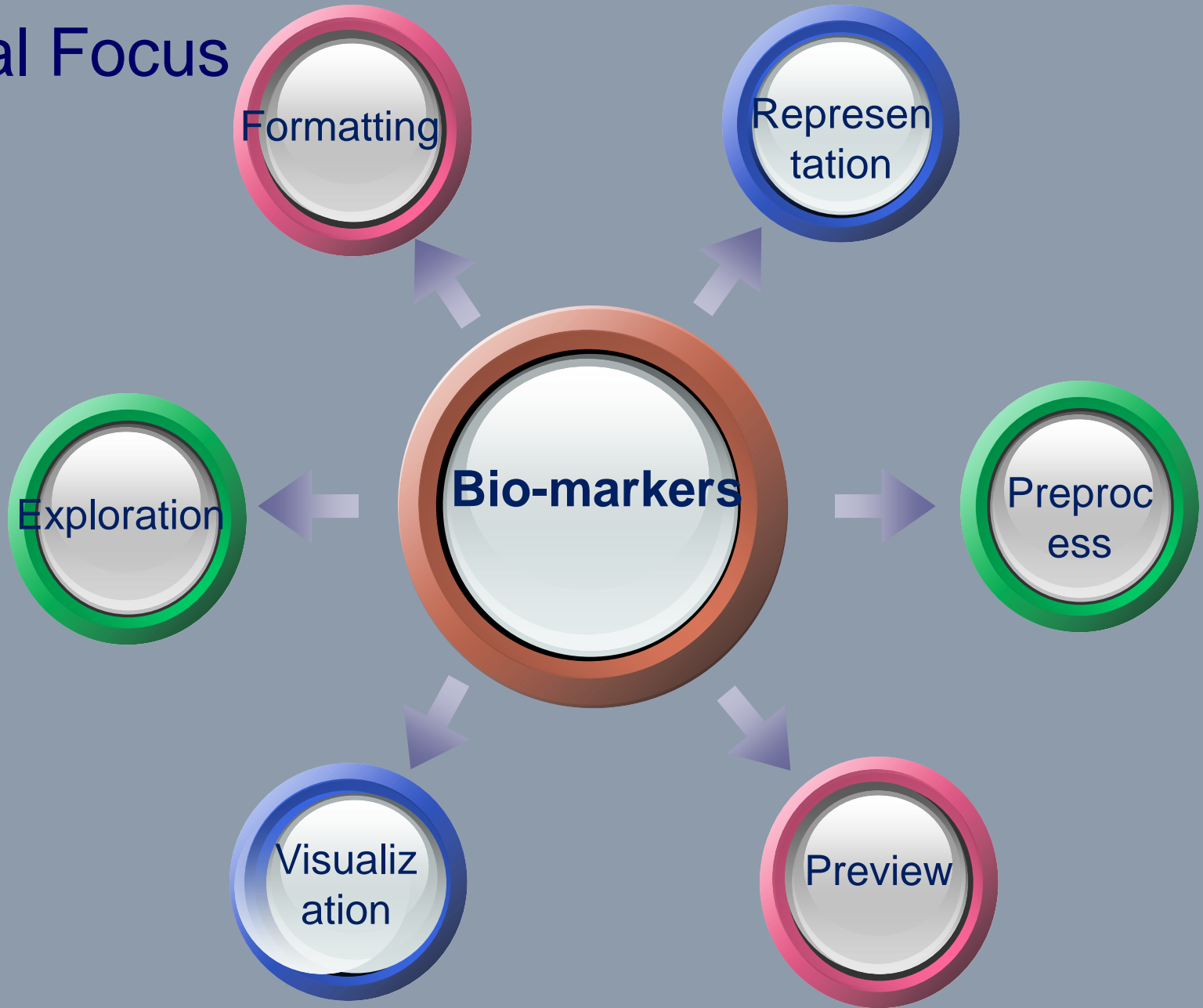
- Patient demographic
- Clinic data
- Historic data

...

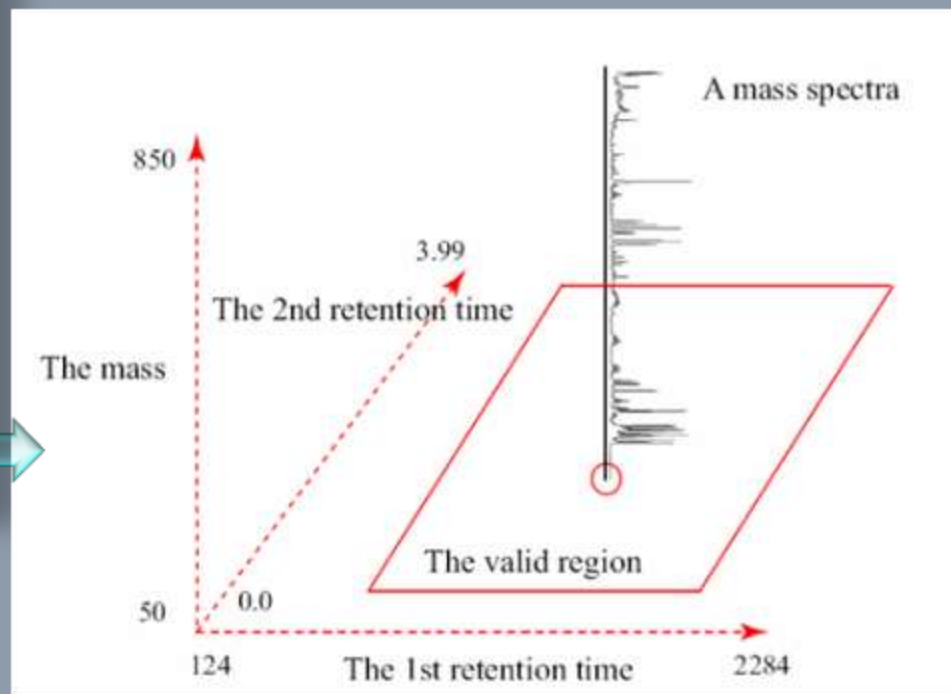
OMICS Samples

- Genomics
- Proteomics
- Metabolomics
- Lipidomics

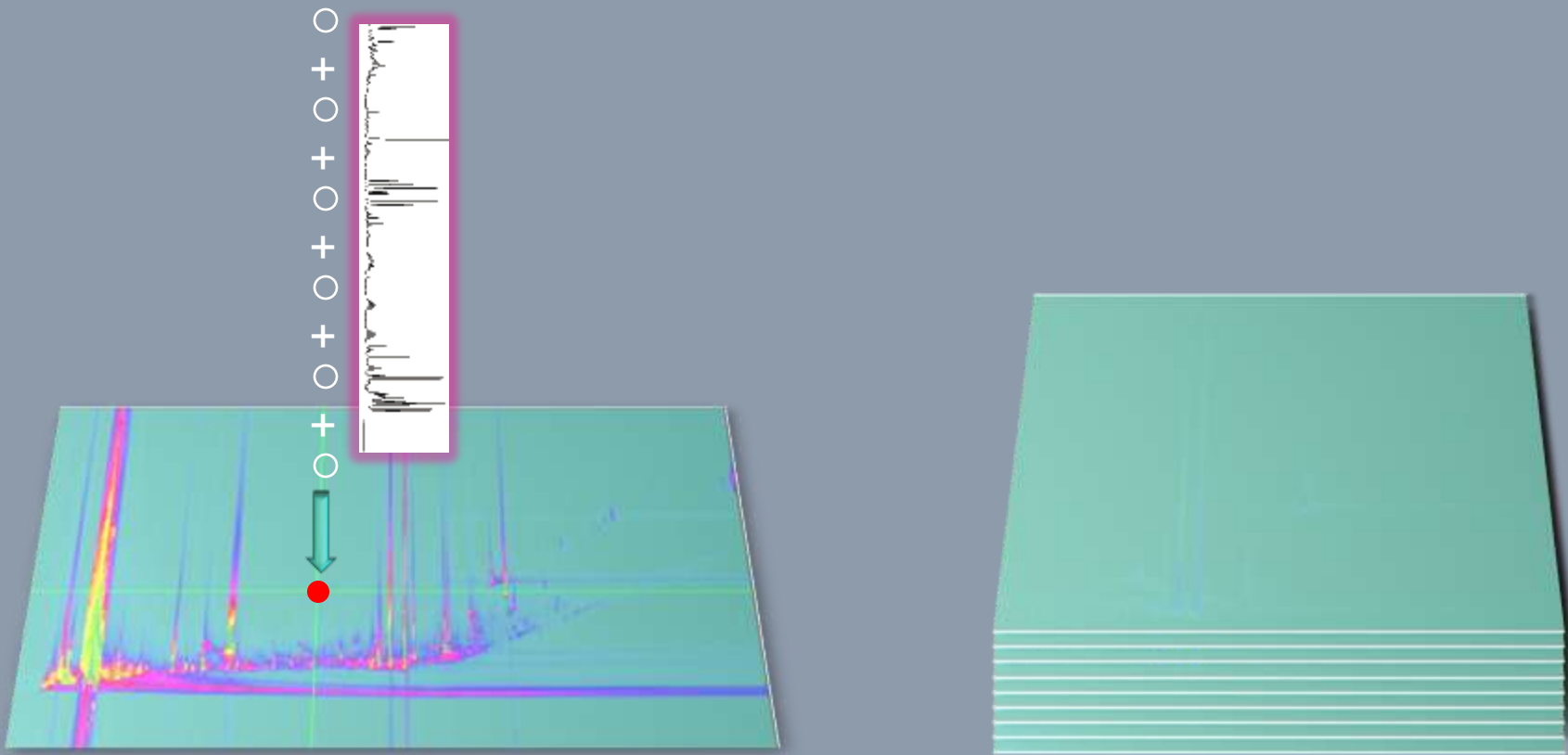
Initial Focus



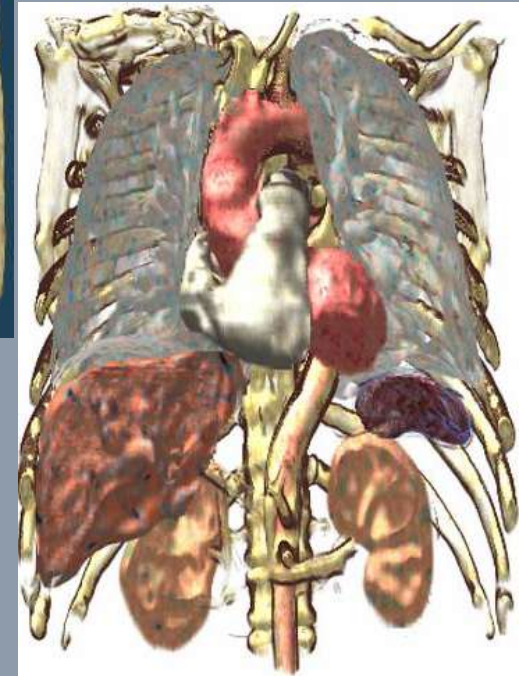
GCxGC-TOF MS Samples (Leco)



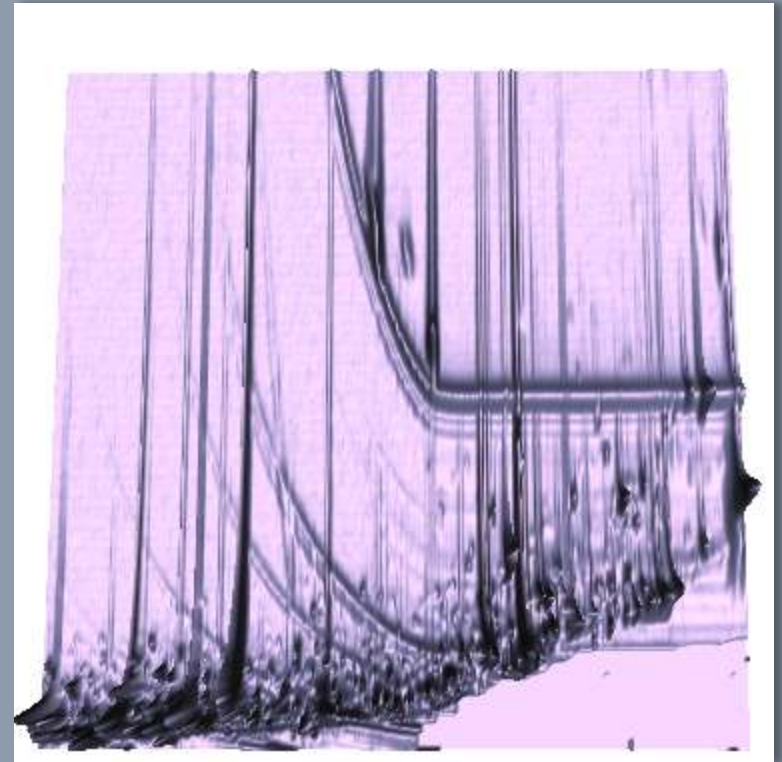
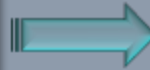
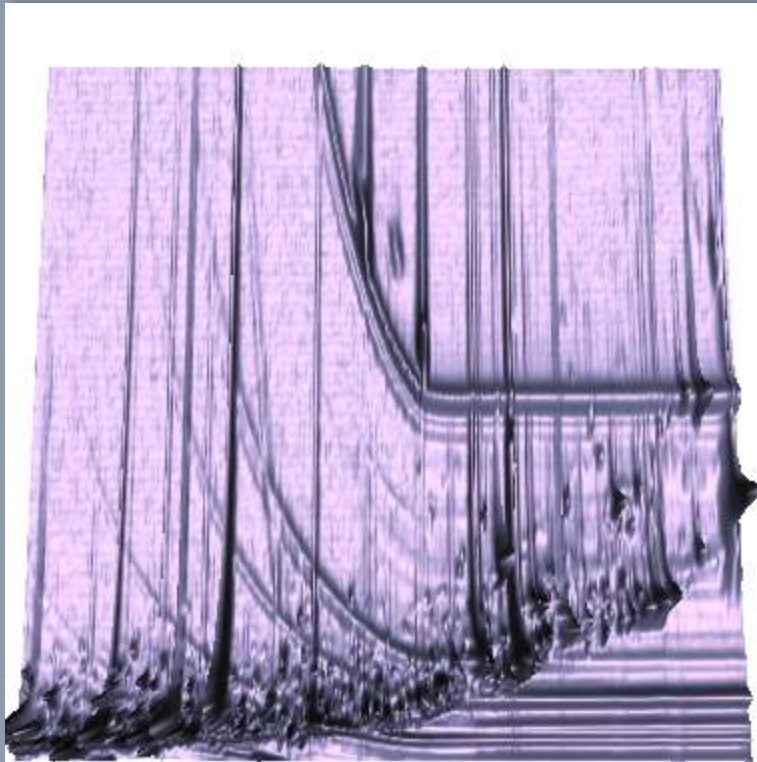
2D TIC vs 3D Volumetric Representation



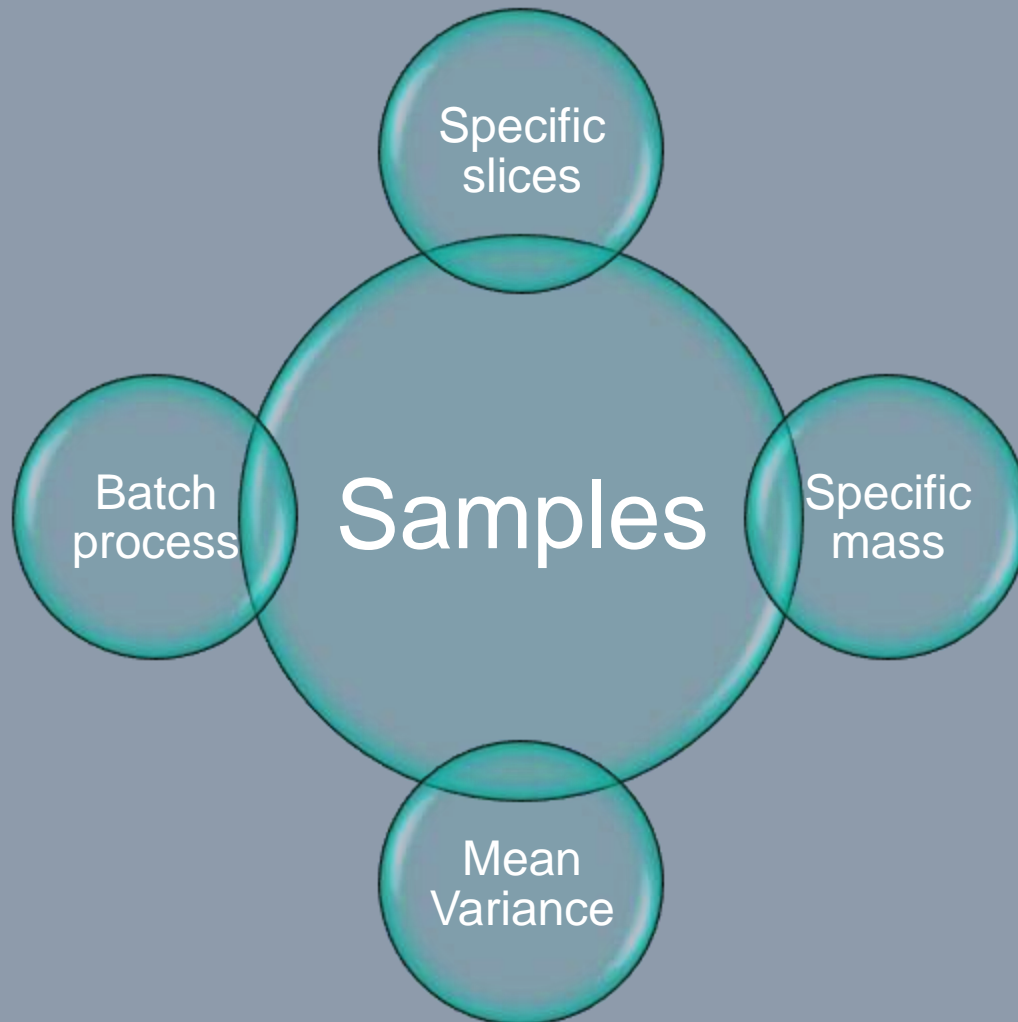
2D TIC vs 3D Volumetric Representation



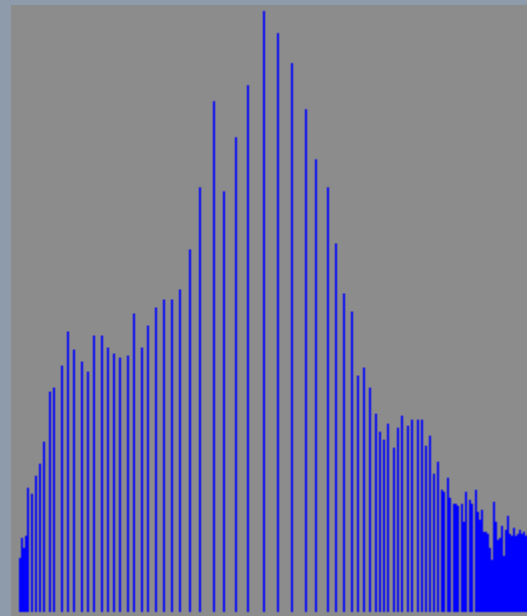
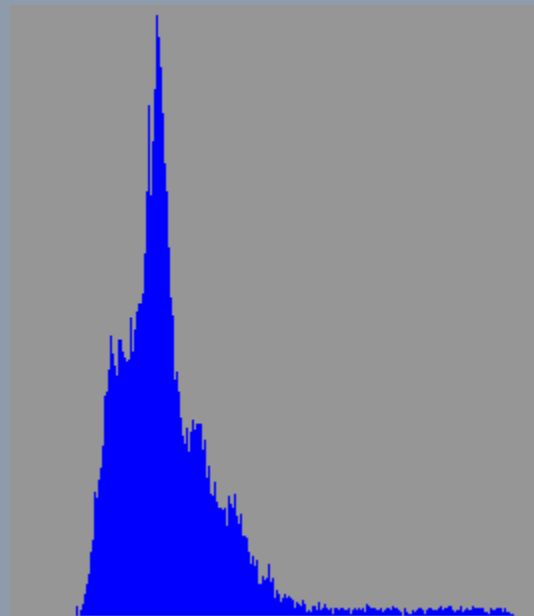
Preprocess: Noise Removal



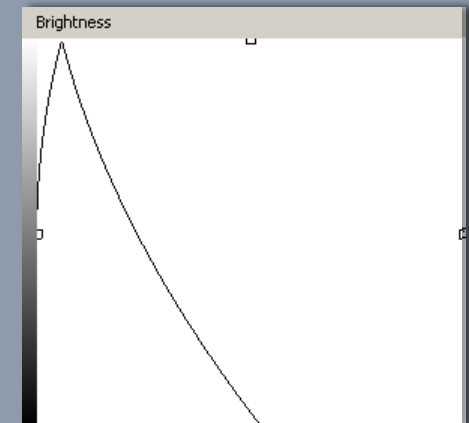
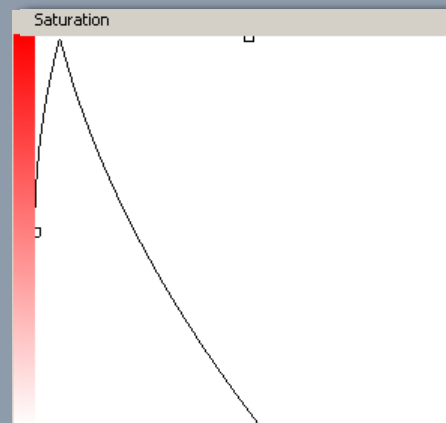
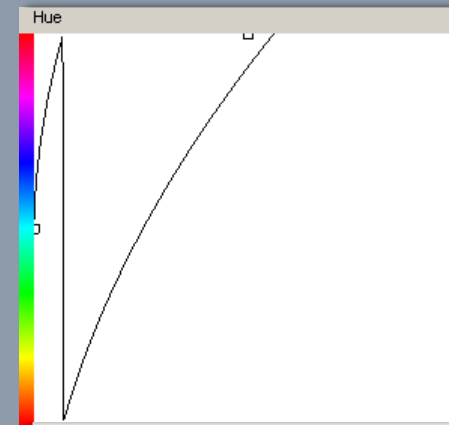
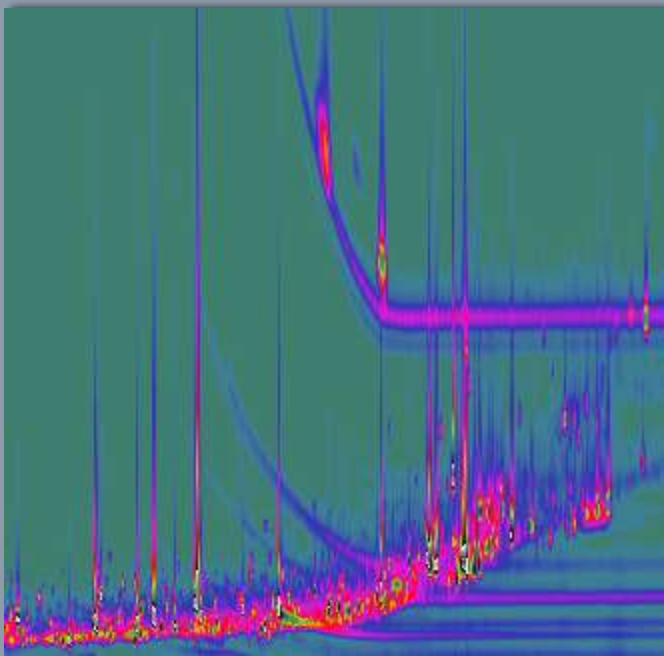
Preprocess: Data Filtering



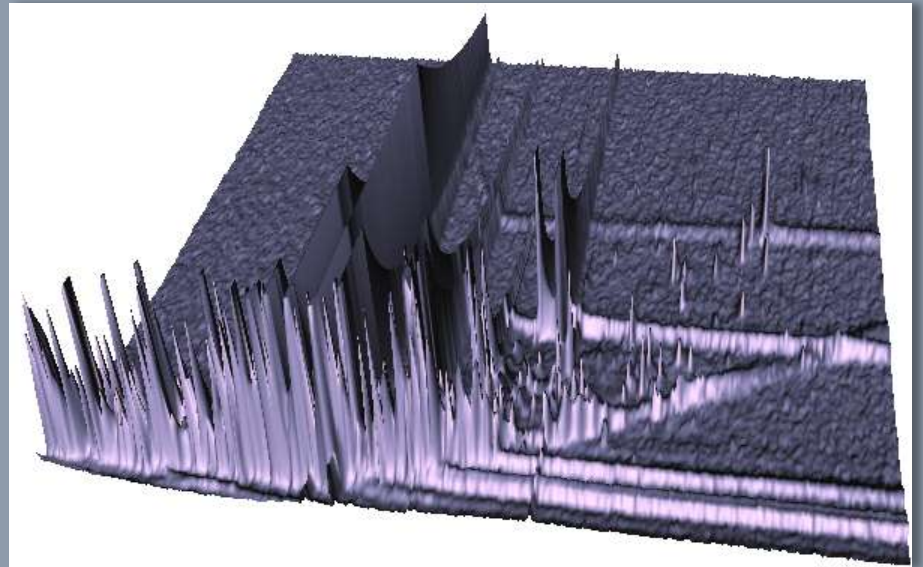
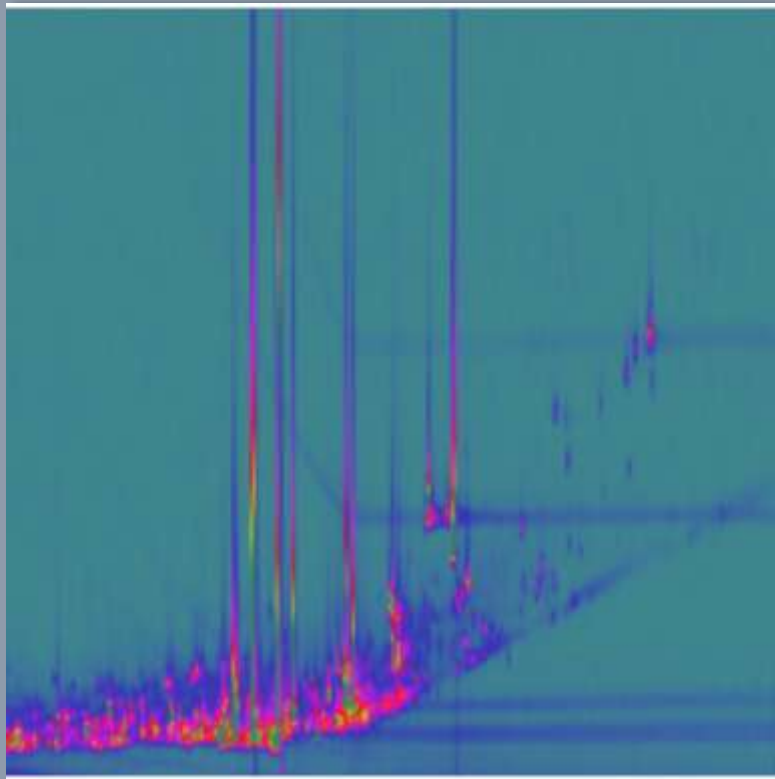
Visualization: Automatic Colorization



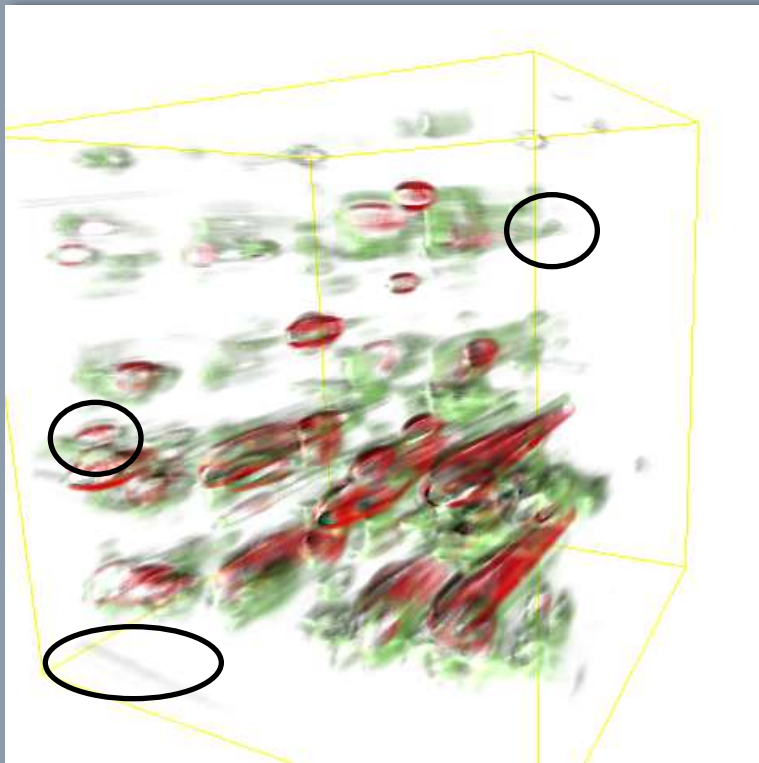
Visualization: Interactive HDR Colorization



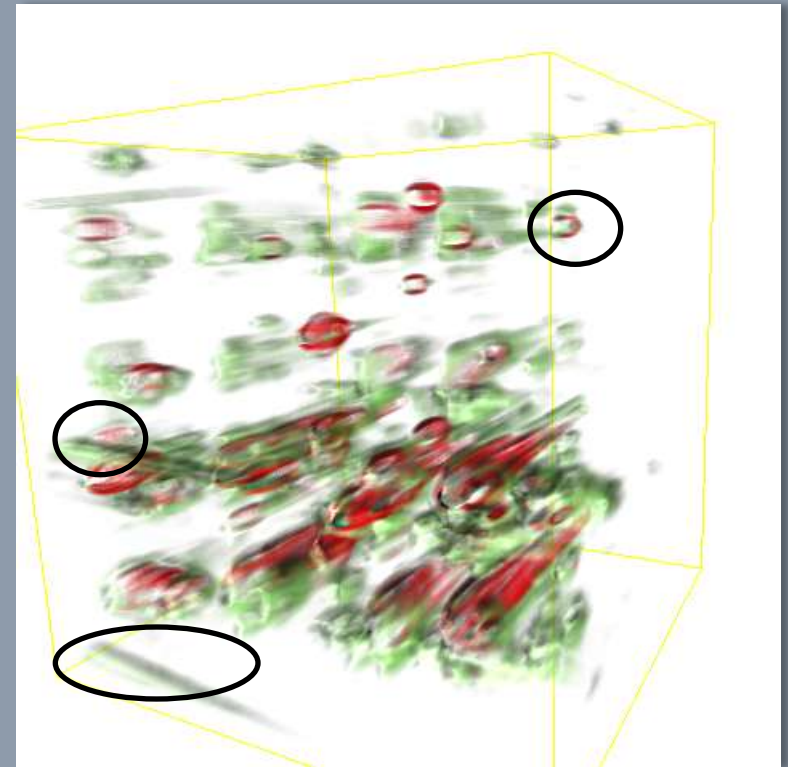
Visualization: Standard Slice View



Visualization: 3D Volume Visualization



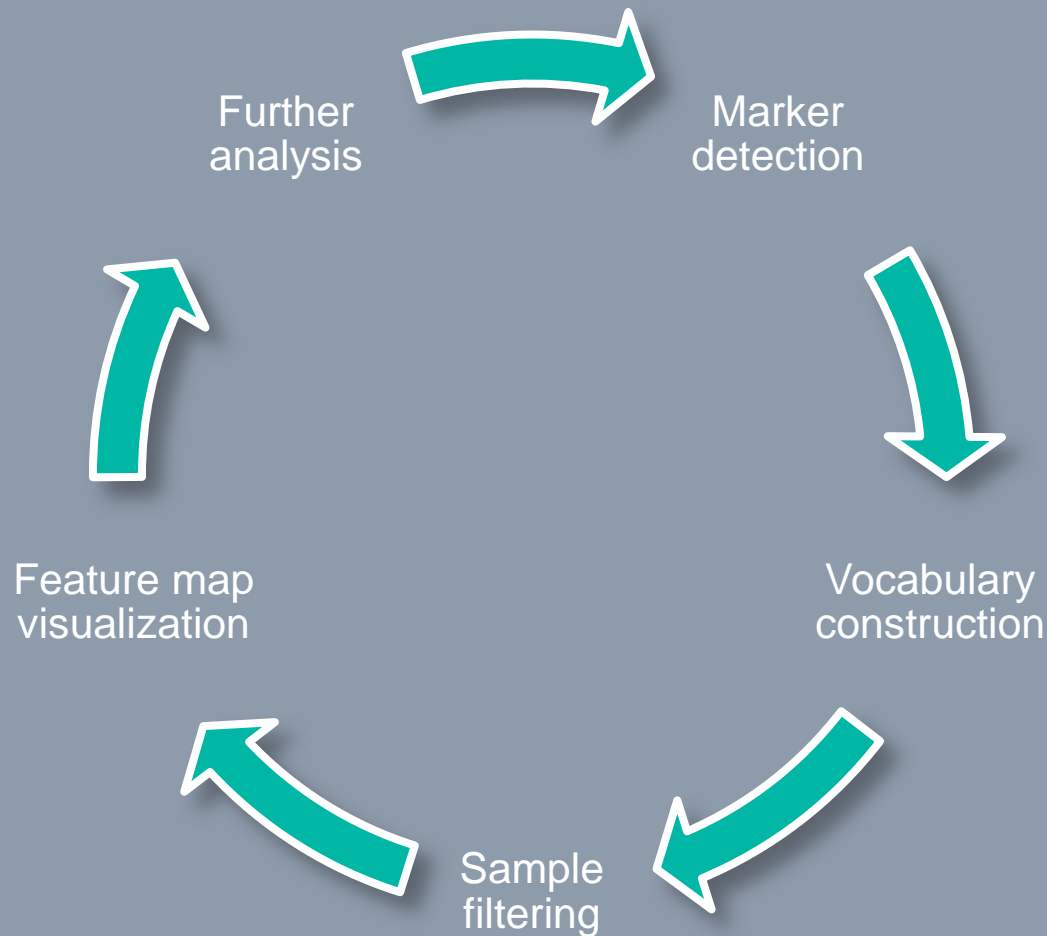
Normal template



Cancer template

$$\alpha_{out} = \alpha_{in} \times (1.0 - k \times variance)$$

Visualization: Detected Bio-markers



Visualization: Detected Bio-markers

Microsoft Excel - 2007-8-23-horizon-sample1_1.csv

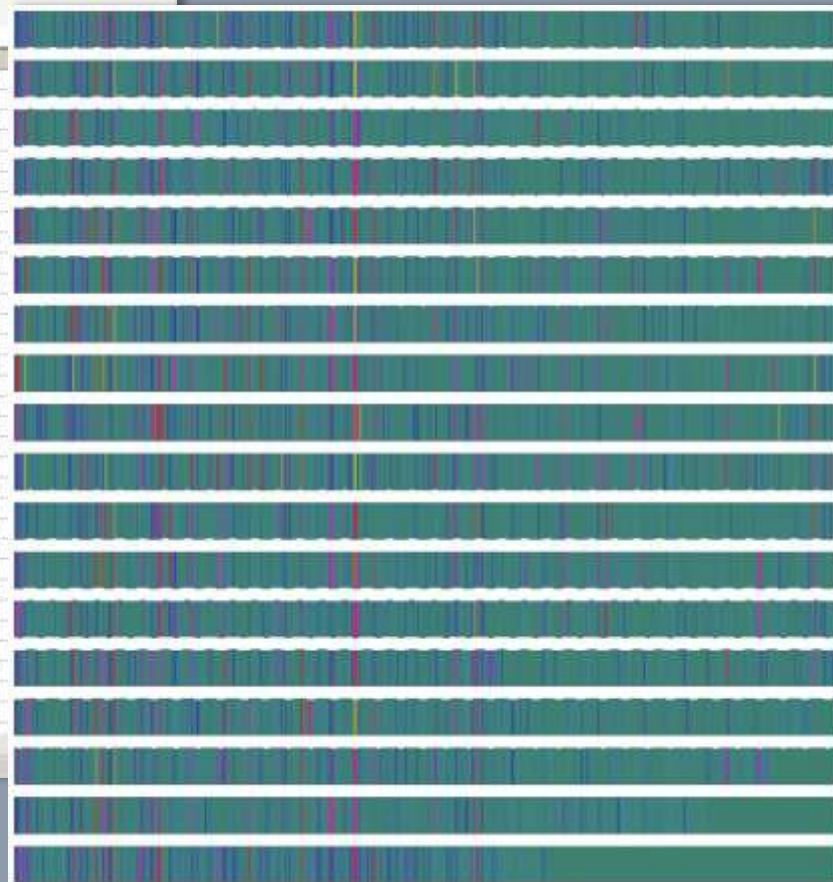
File Edit View Insert Format Tools Data Window Help Adobe PDF

Type a question for help

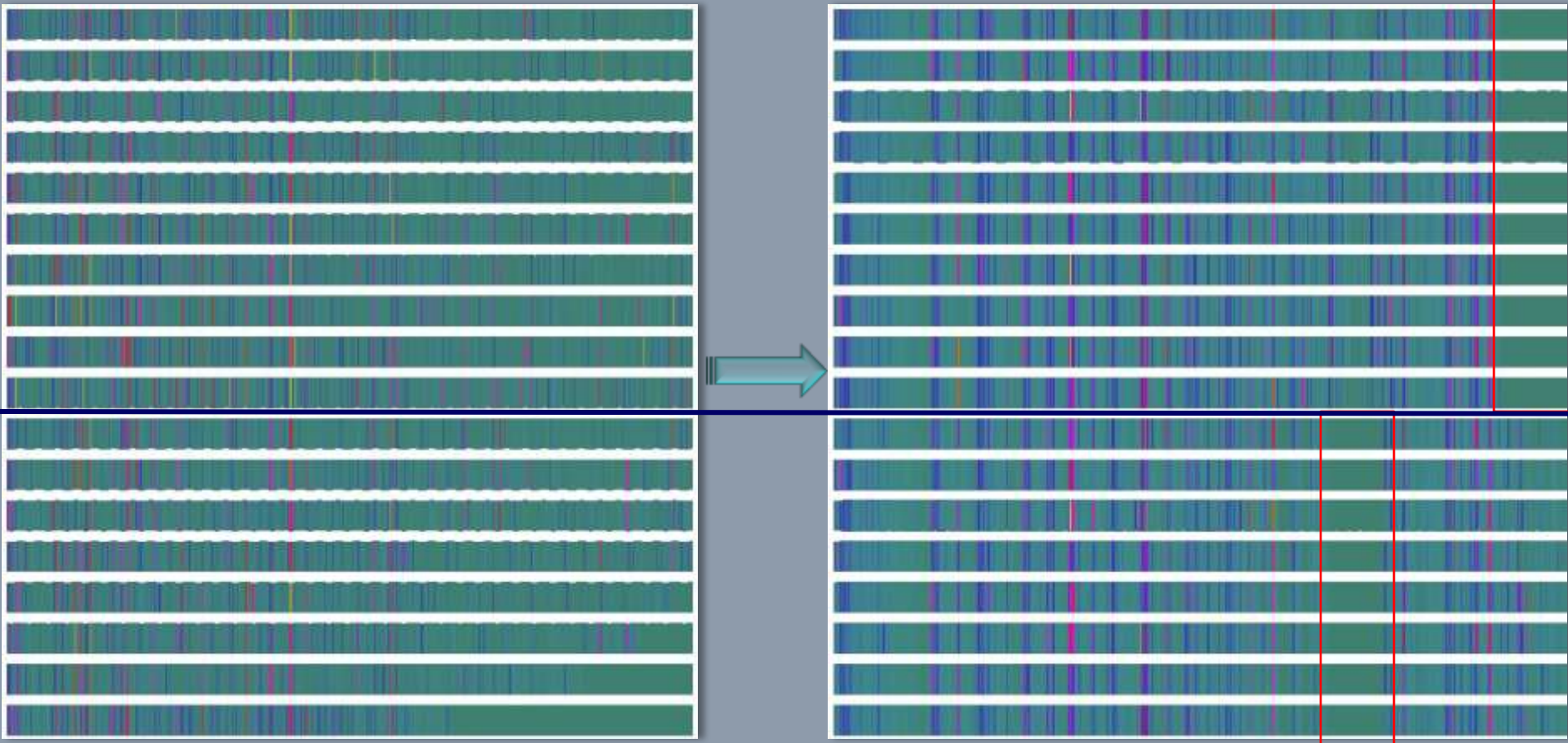
Arial

	A	B	C	D	E	F	G	H	I	J	K	L	
6061	Bis(2-furfur	2276	0.51	918043	134169	Bis(2-furfur	330.43	Chuck Arc	81	T		609	Bis(2-furfur
6062	Unknown 4	2276	0.68	466361	46152	7-Hydroxy-	40.744	A.A.Kutin,	253	T		438	7-Hydroxy-
6063	n-Hexadec	2276	0.96	530711	81250	n-Hexadec	74.151	Chemical f	60	T		886	n-Hexadec
6064	11-cis-Oct	2276	1.29	83258	9533.5	11-cis-Oct	12.197	O.A.MAMI	75	T		612	11-cis-Oct
6065	Unknown 4	2276	1.33	49560	4952.6	9,12-Octac	12.197	J.M.Halke	337	T		381	9,12-Octac
6066	Unknown 4	2276	1.62	9332	1364	Pentacont	3.3590	A.RAAL IN	116	T		318	Pentacont
6067	Silane, [(C	2276	1.79	239282	17368	Silane, [(C	7.5689	STER PRE	117	T		647	Silane, [(C
6068	Unknown 4	2276	1.82	52642	3073.3	3-Trimethy	7.5689	V.G.Zaikin	101	T		419	3-Trimethy
6069	Unknown 4	2276	2.68	93856	5379.8	Cholester	13.249	LAC, NIDC	147	T		438	Cholester
6070	Unknown 4	2276	2.73	156652	10591	Cholest-5-	13.249	RADIAN C	91	T		592	Cholest-5-
6071	Unknown 4	2280	0.34	469.46	299	psi, psi-(0.73637	C.R.ENZE	91	T		400	psi, psi-(
6072	Silane, chl	2280	0.53	1842870	269476	Silane, chl	330.67	RADIAN C	55	T		634	Silane, chl
6073	Cyclotrisil	2280	0.57	1828144	268842	Cyclotrisil	330.18	NIST Mass	207	T		831	Cyclotrisil
6074	Cyclotetra	2280	0.61	2762549	403703	Cyclotetra	330.67	Chemical f	281	T		802	Cyclotetra
6075	Cyclopent	2280	0.63	3726463	541495	Cyclopent	331.77	Japan AIS	267	T		689	Cyclopent
6076	Unknown 4	2280	0.66	1855374	270005	t-Butyl-(2-	331.77	Chemical f	341	T		538	t-Butyl-(2-
6077	Unknown 4	2280	0.87	251262	46442	Phenol, 2-	67.639	T.SPAND	253	T		529	Phenol, 2-
6078	Unknown 4	2280	0.93	307830	50142	Hexadecar	64.076	Chemical f	135	T		513	Hexadecar
6079	Bicyclo[10	2280	1.13	283489	31048	Bicyclo[10	76.464	Chemical f	150	T		729	Bicyclo[10
6080	Unknown 4	2280	2.72	102847	5211.2	Cholest-5-	12.834	RADIAN C	107	T		456	Cholest-5-
6081	Unknown 4	2284	0.29	97407	5076.5	psi, psi-(12.502	C.R.ENZE	145	T		367	psi, psi-(
6082	Unknown 4	2284	0.71	365604	29101	Cyclopent	34.164	Chemical f	207	T		540	Cyclopent
6083	Unknown 4	2284	0.74	173059	13872	Nonanedio	34.164	J.M.Halke	401	T		485	Nonanedio
6084	Unknown 4	2284	0.76	576780	45045	3-Cyclohe	34.164	V.Zaikin,Te	285	T		525	3-Cyclohe
6085	6-Dimethyl	2284	0.79	175717	14044	6-Dimethyl	34.587	Vladimir Zi	217	T		623	6-Dimethyl
6086	Hexadecar	2284	1.07	193102	26243	Hexadecar	64.632	M.G.HORI	75	T		702	Hexadecar
6087	11-cis-Oct	2284	1.29	38894	3969.3	11-cis-Oct	9.7755	O.A.MAMI	75	T		623	11-cis-Oct
6088	Unknown 4	2284	1.42	19537	2609	Butane, 2-	2.1307	O.A.MAMI	117	T		563	Butane, 2-
6089	Unknown 4	2284	2.64	87529	4689.8	Pentacont	11.55	A.RAAL IN	129	T		315	Pentacont
6090	Unknown 4	2284	2.66	87529	4689.8	Stigmasta	11.55	LAC, NIDC	79	T		389	Stigmasta
6091	Unknown 4	2284	2.71	87529	4689.8	Cholest-5-	11.55	RADIAN C	91	T		528	Cholest-5-
6092	Unknown 4	2284	3.19	31886	2222.5	Pentacont	5.4735	A.RAAL IN	237	T		330	Pentacont

Ready

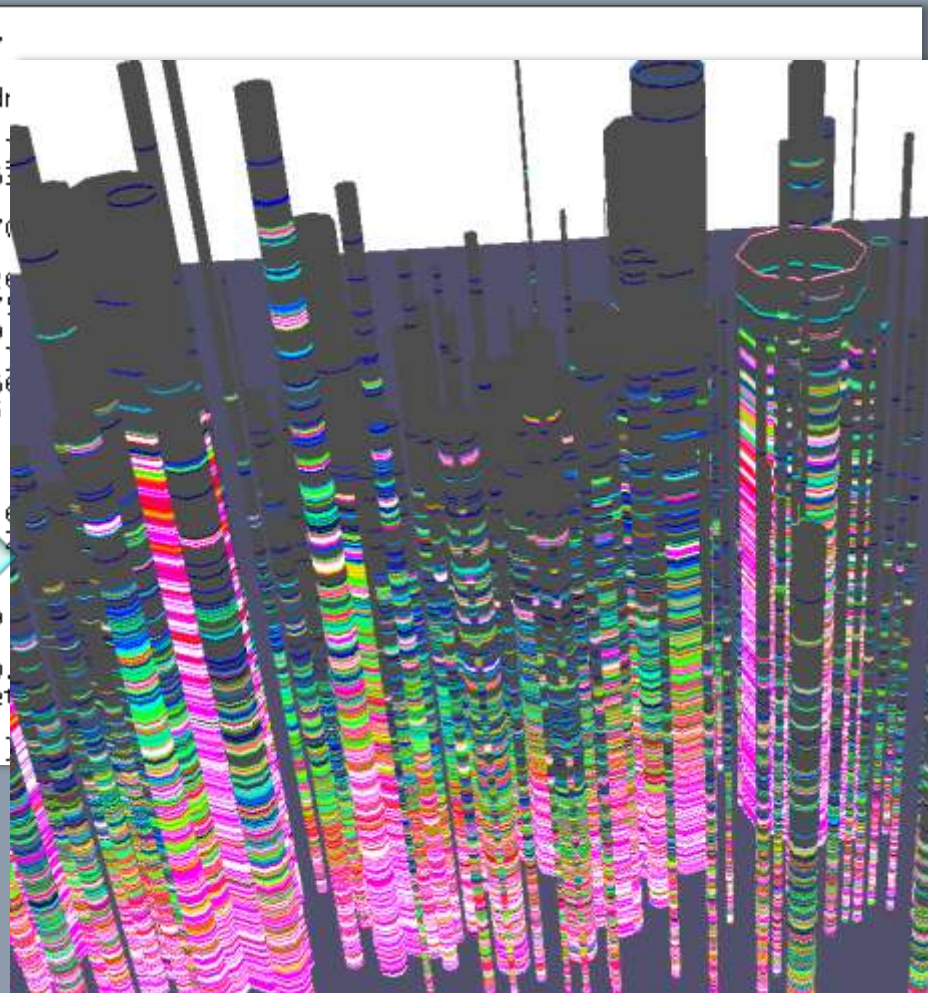


Visualization: Detected Bio-markers

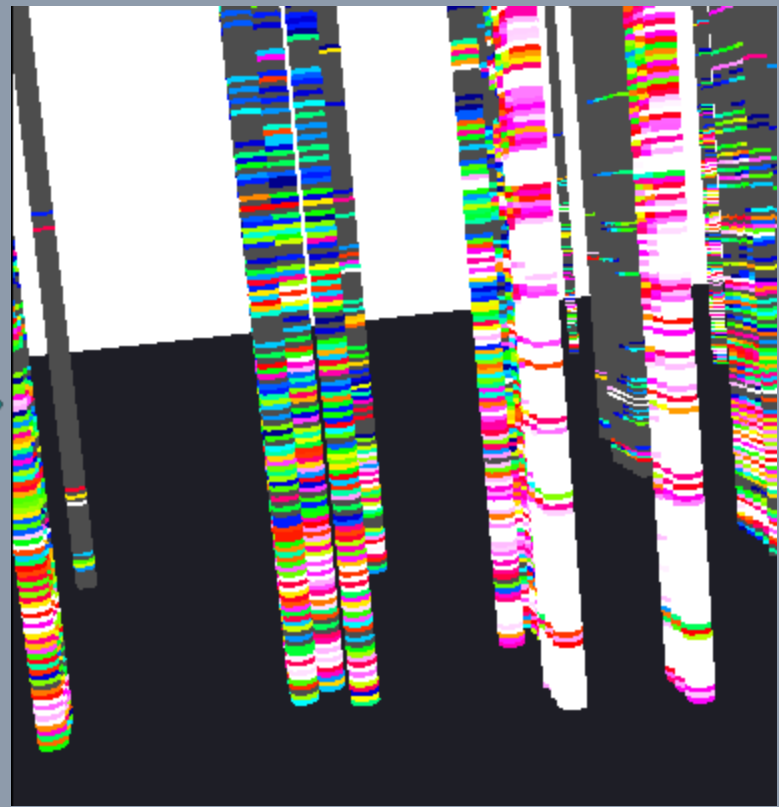
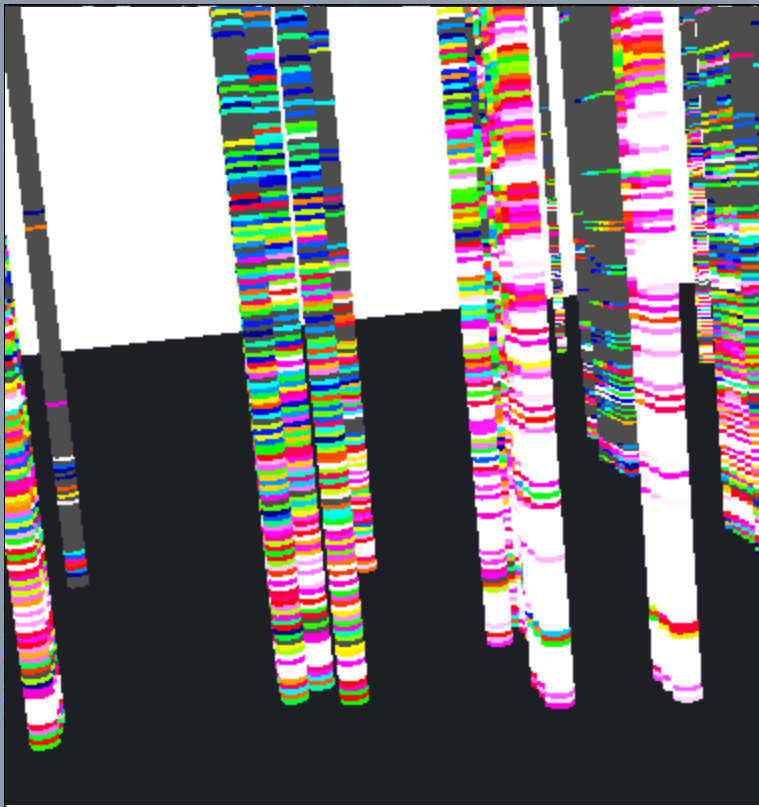


Exploration: 3D Mass Spectrum

"1-Dimethylhexylsilyloxyhexane	652	0.83	17580622	686
"spiro[4.5]decane, 6-methylene-"	652	0.87	11008814	687
"Undecane, 2,6-dimethyl-"	656	0.81	5931229	793
"Tricyclo(3,3,1,1(3,7)]decane-1-carboxylic acid, 2-hydr				
"2,4,6-Cycloheptatrien-1-one"	660	0.79	4438392	647
"Acetamide, 2,2,2-trifluoro-N-methyl-N-(trimethylsilyl)				
"Acetic acid, trimethylsilyl ester"	668	0.83	3336759	63
"1,2-Dipropylcyclopropene"	668	0.86	4484779	612
"Acetic acid, trimethylsilyl ester"	668	0.93	6549612	70
"Indan, 1-methyl-"	668	0.96	6220412	747
"Propanedioic acid, bis(trimethylsilyl) ester"	668	1.20		
"Chloroacetic acid, 3-pentadecyl ester"	672	0.82	599071	
"1,3-Oxathiane, 4,6-dimethyl-, cis-"	680	0.93	15347149	
"Acetamide, 2,2,2-trifluoro-N-methyl-N-(trimethylsilyl)				
"1-oxa-4,6-diazacyclooctane-5-thione"	684	0.91	1670076	
"Ethanethioic acid, S-(1-methylpropyl) ester"	684	0.95		
"L-Homoserine, O-ethyl-"	684	0.98	15241908	657
"Urea, N,N'-dimethyl-"	684	1.05	1012503	665
"2,4,6-Cycloheptatrien-1-one"	688	0.78	3555811	714
"1-Dimethyl(isopropyl)silyloxypropane"	688	0.92	1412161	6
"n-Pentanoic acid, allyldimethylsilyl ester"	692	0.85		
"2-Pyrrolidinone, 4-methyl-"	692	1.07	174209	740
"silane, triethoxymethyl-"	696	0.81	3872551	621
"3-Pentanol, 2-chloro-4-methyl-, (R*,S*)-(C)-"	696	0.89		
"2-Cyclopenten-1-one, 2-hydroxy-"	696	1.05	582046	686
"Pyridine-4-carbohydrazide, N2-trifluoroacetyl-"	700	0.		
"Oxane, 4-(1-hydroxy-2-dimethylaminoethyl)-4-(3,4-dimet				
"Cyclotetrasiloxane, octamethyl-"	704	0.79	541238	602
"Acetamide, 2,2,2-trifluoro-N-methyl-N-(trimethylsilyl)				



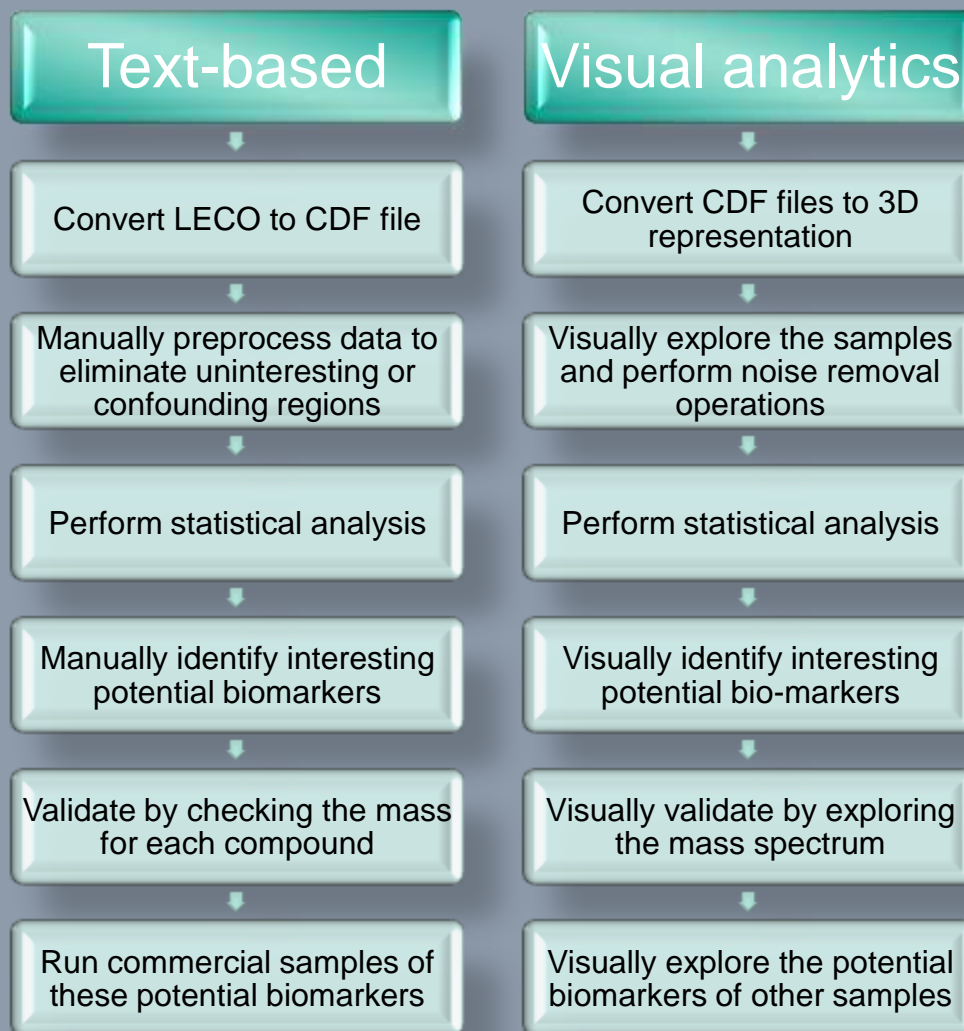
Exploration: 3D Comparative Navigation



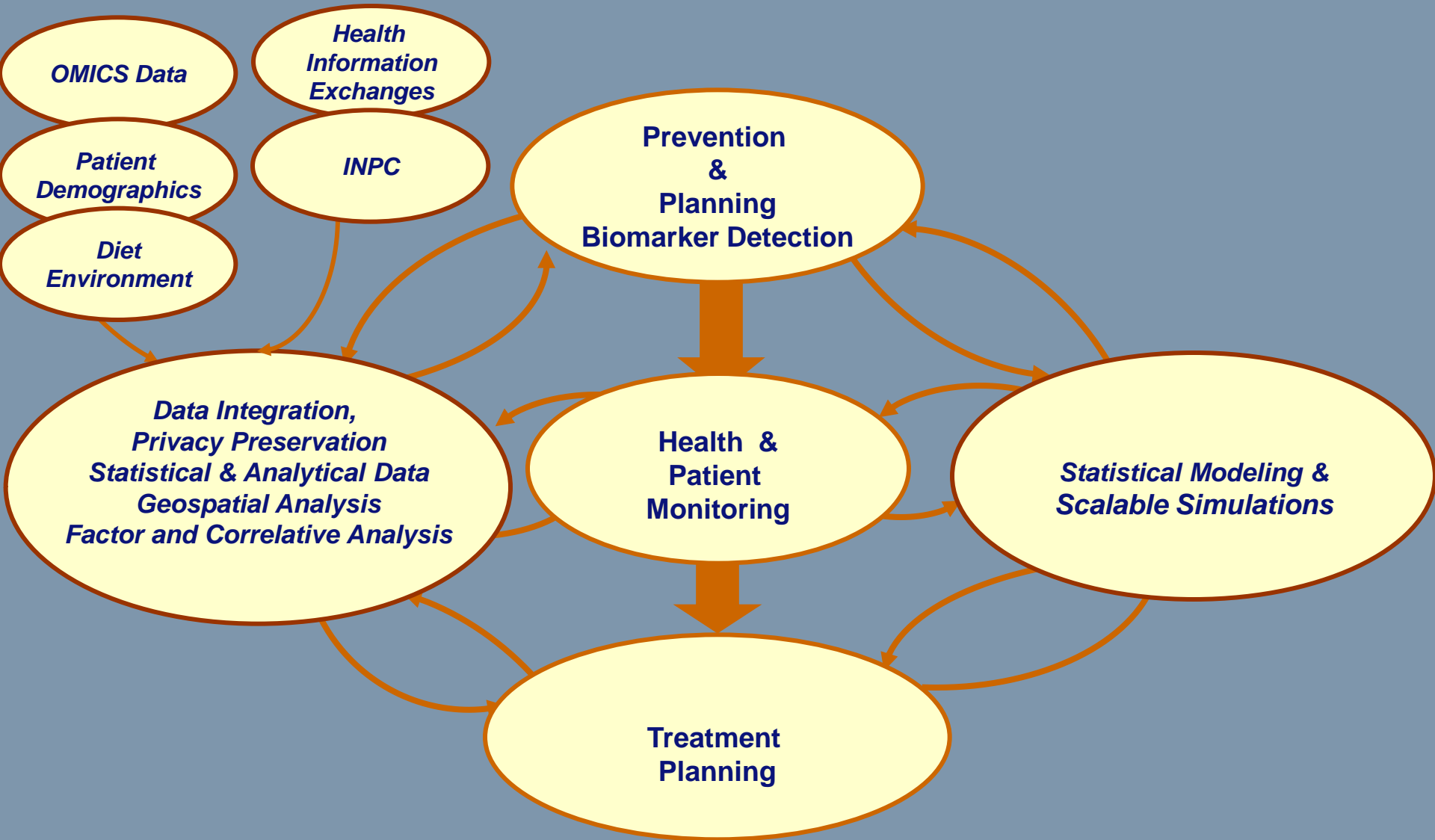
Comparison



Revolution of the Working Mode



Visual Analytics for Cancer Care Engineering



Demonstrations

Noise Removal

3D Volume Rendering

3D Comparative Exploration

Acknowledgements

- Lingyan Liu (Department of Chemistry)
- Daniel Raftery (Department of Chemistry)
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- Phil Livengood from PURVAC
- All project colleagues