



Determination of the 3D Trajectory of Coronal Mass Ejections using Stereoscopy

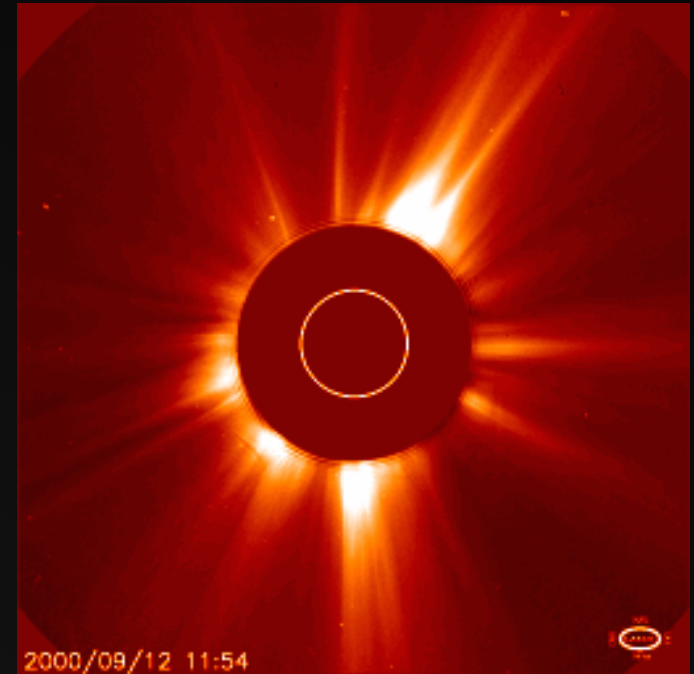
Vahab Pournaghshband
University of California, Berkeley
JPLUS/SURF

Mentor: Dr. Paulett Liewer



What is a CME?

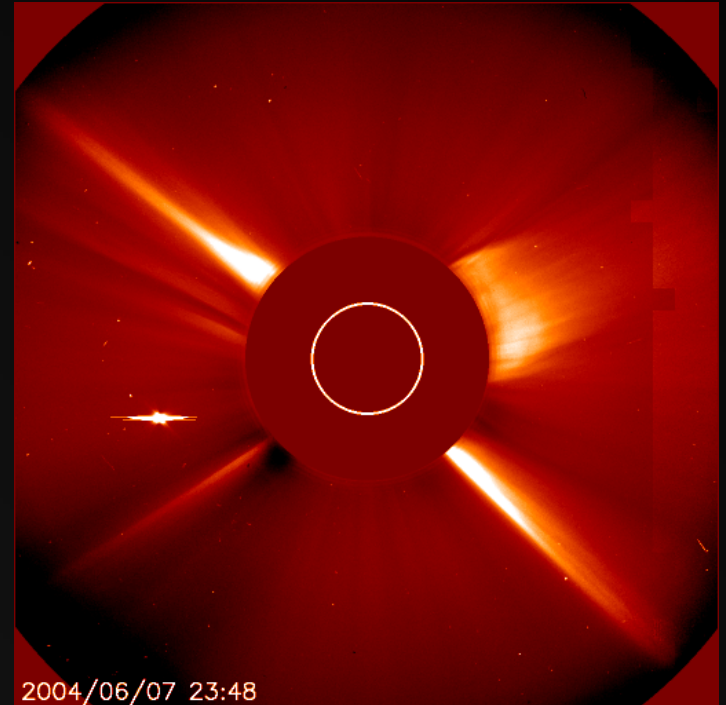
- Coronal Mass Ejections
- Corona: Sun's Atmosphere
- CME: Portion of Corona Blasted into the Solar Wind
- Velocity: 300~2000 to (km/s)
- Consists of Electrons, Ions, Magnetic Field



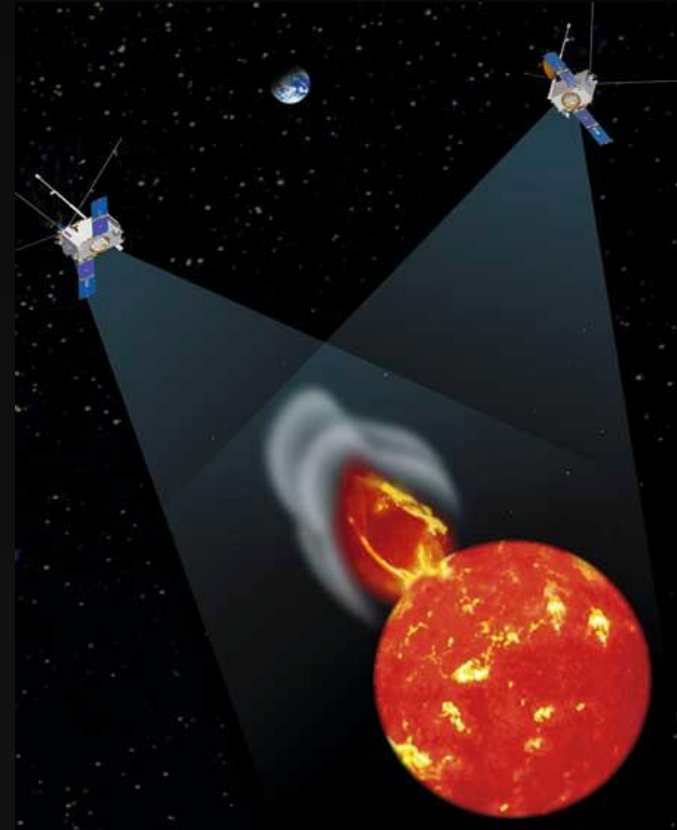
Why Studying CMEs?

- Communications Systems Disruption
Satellite, GPS, Cell phones etc
- Astronauts' Radiation Exposure
- Electric Power Outage

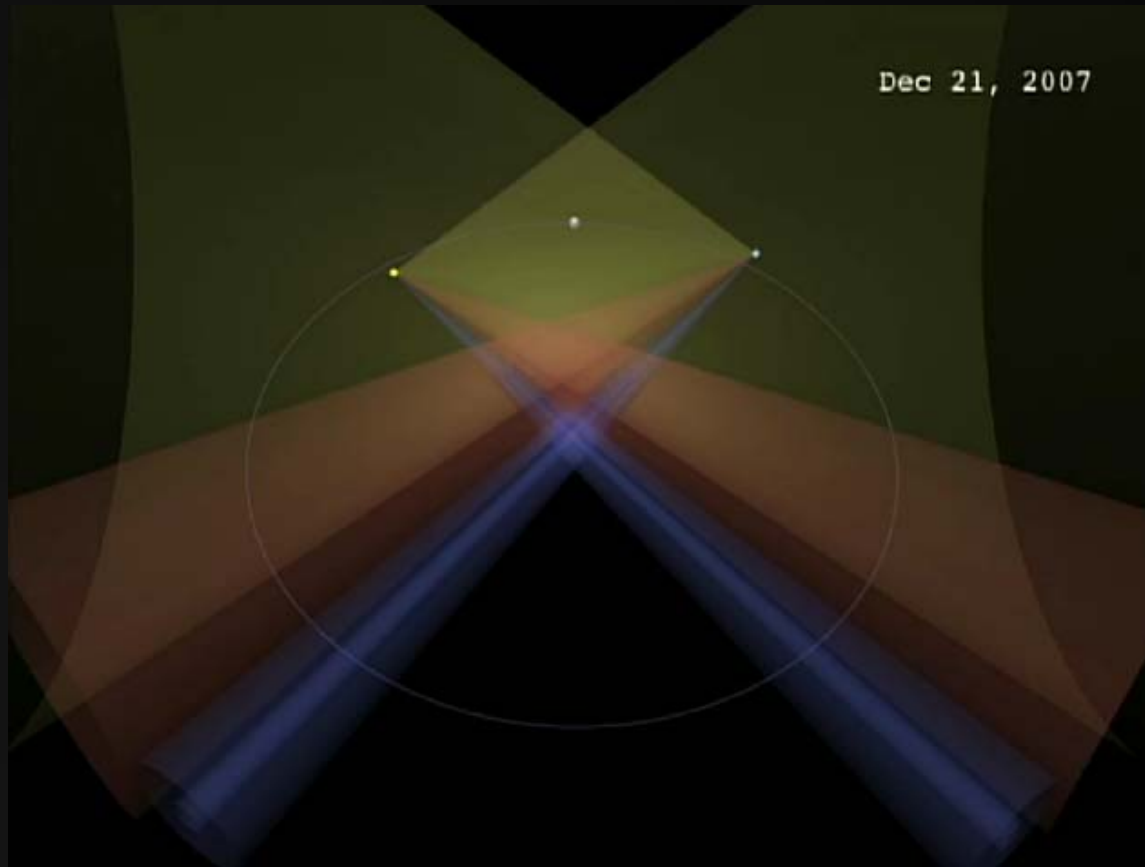
Solution: SOHO?



Solution: STEREO

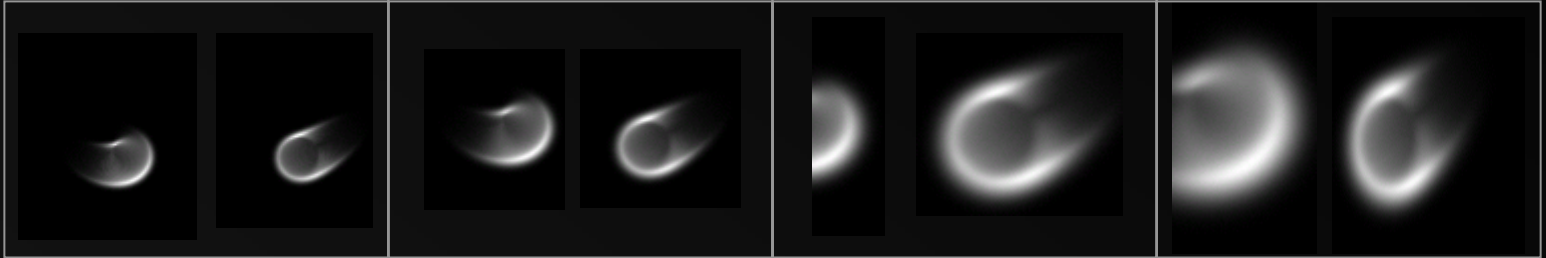


STEREO Field of View

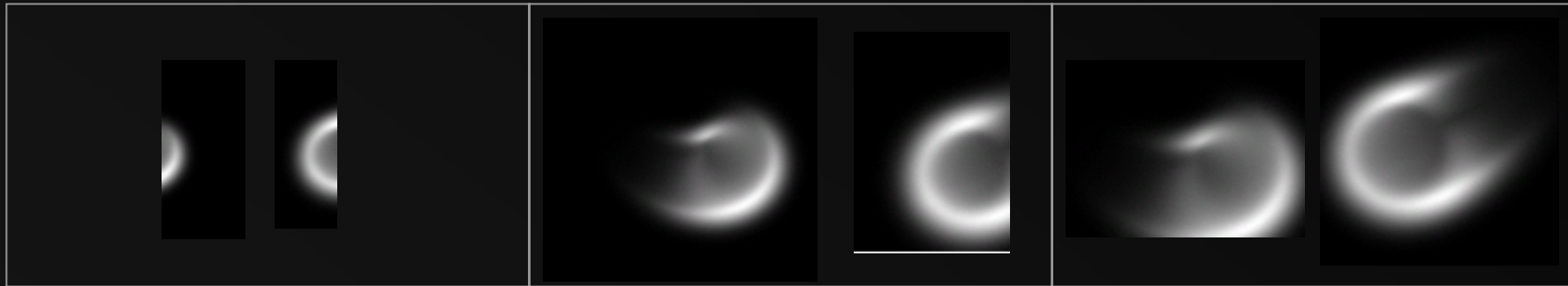


Simulated STEREO Data

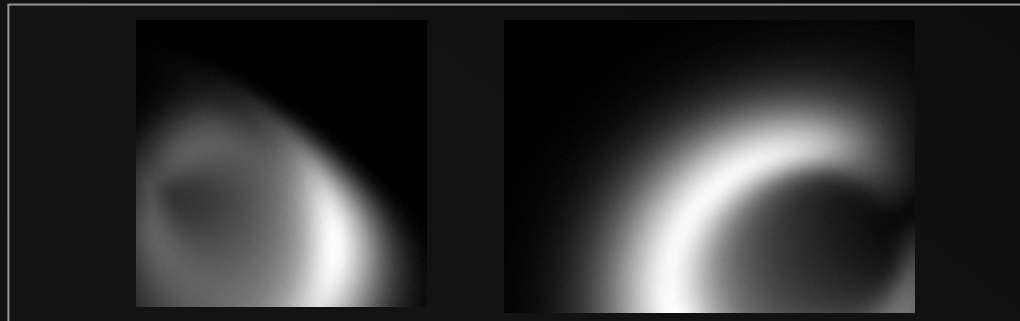
C2



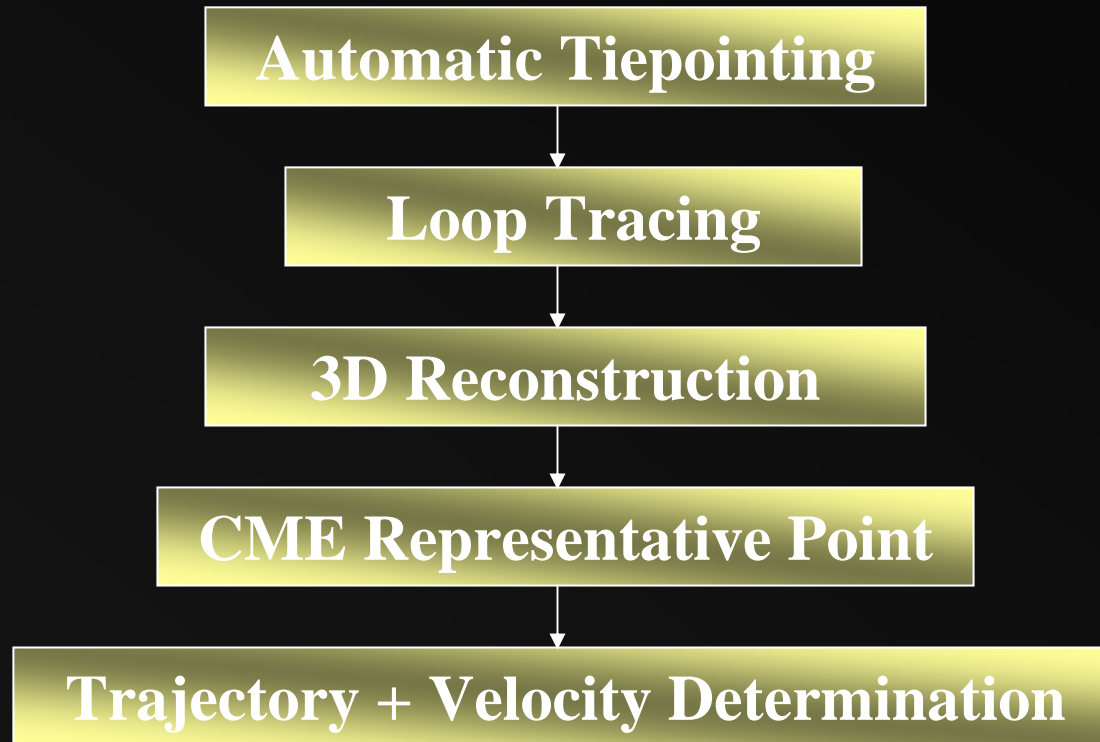
H1



H2



Approach



Approach

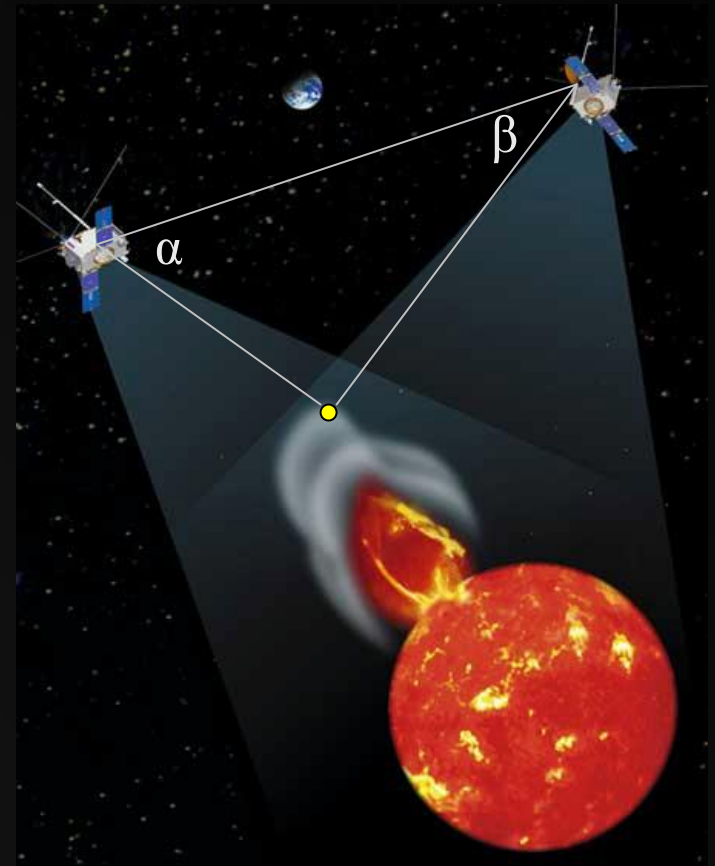
Automatic Tiepointing

Loop Tracing

3D Reconstruction

CME Representative Point

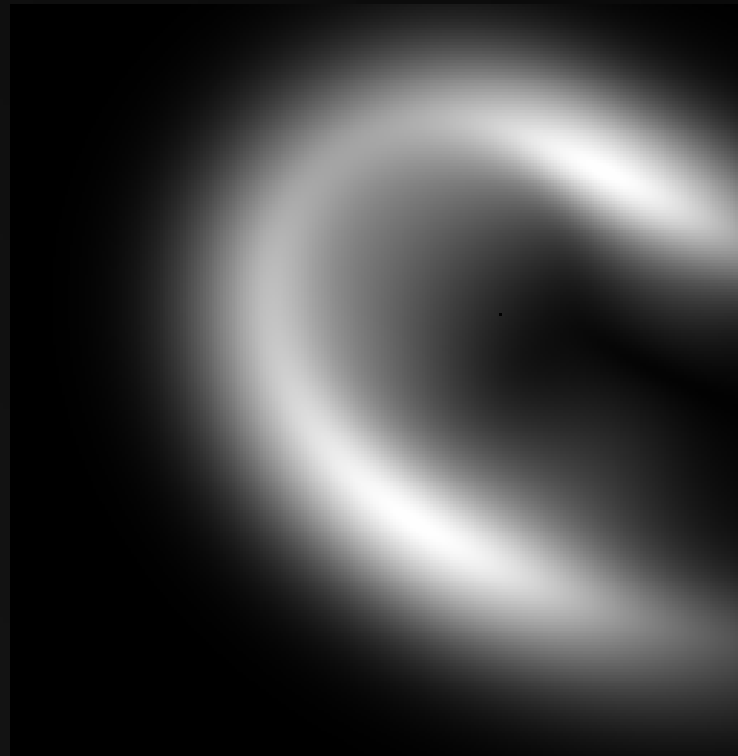
Trajectory + Velocity Determination



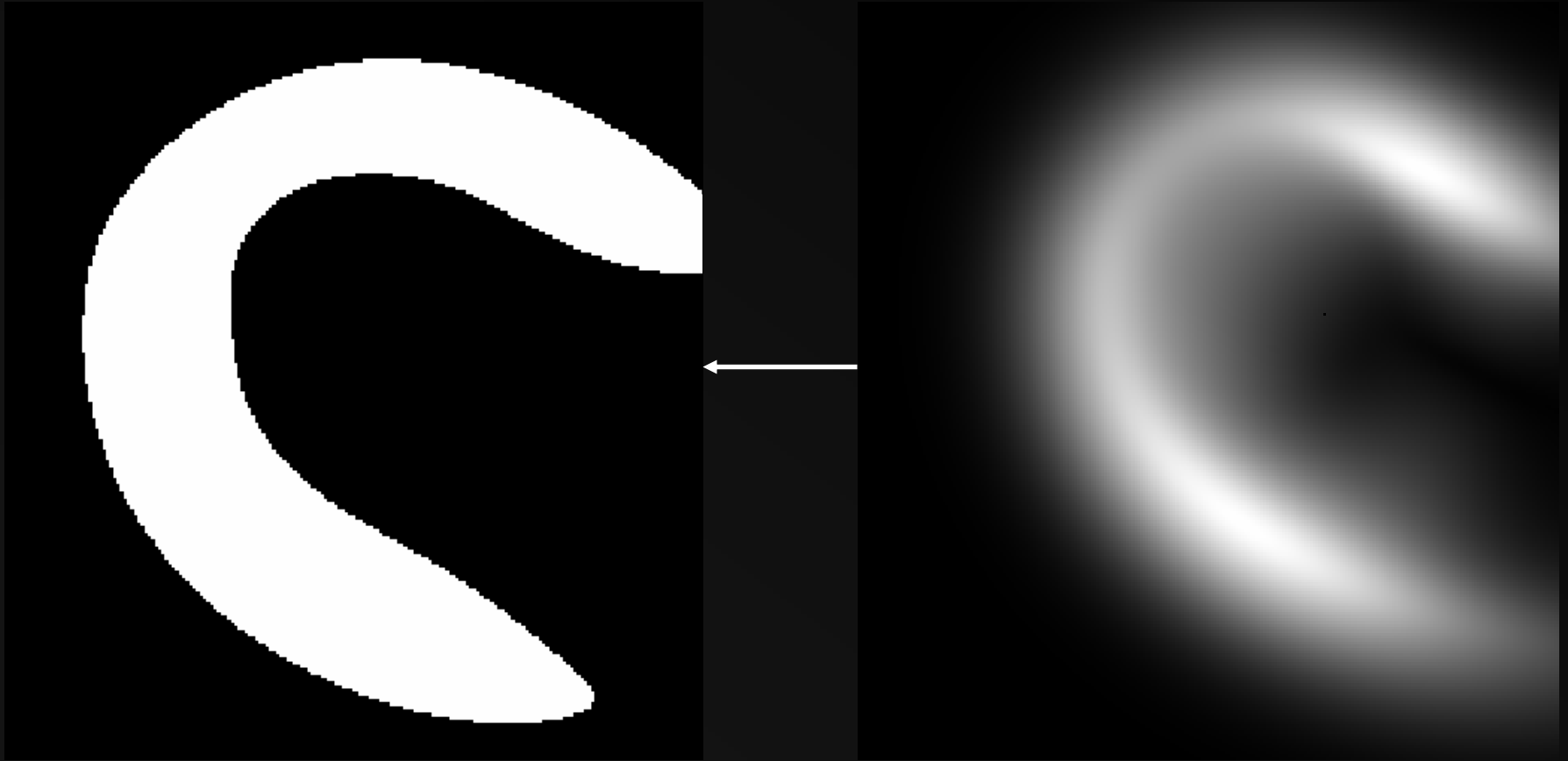
Automatic Tiepointing



Masking



Masking

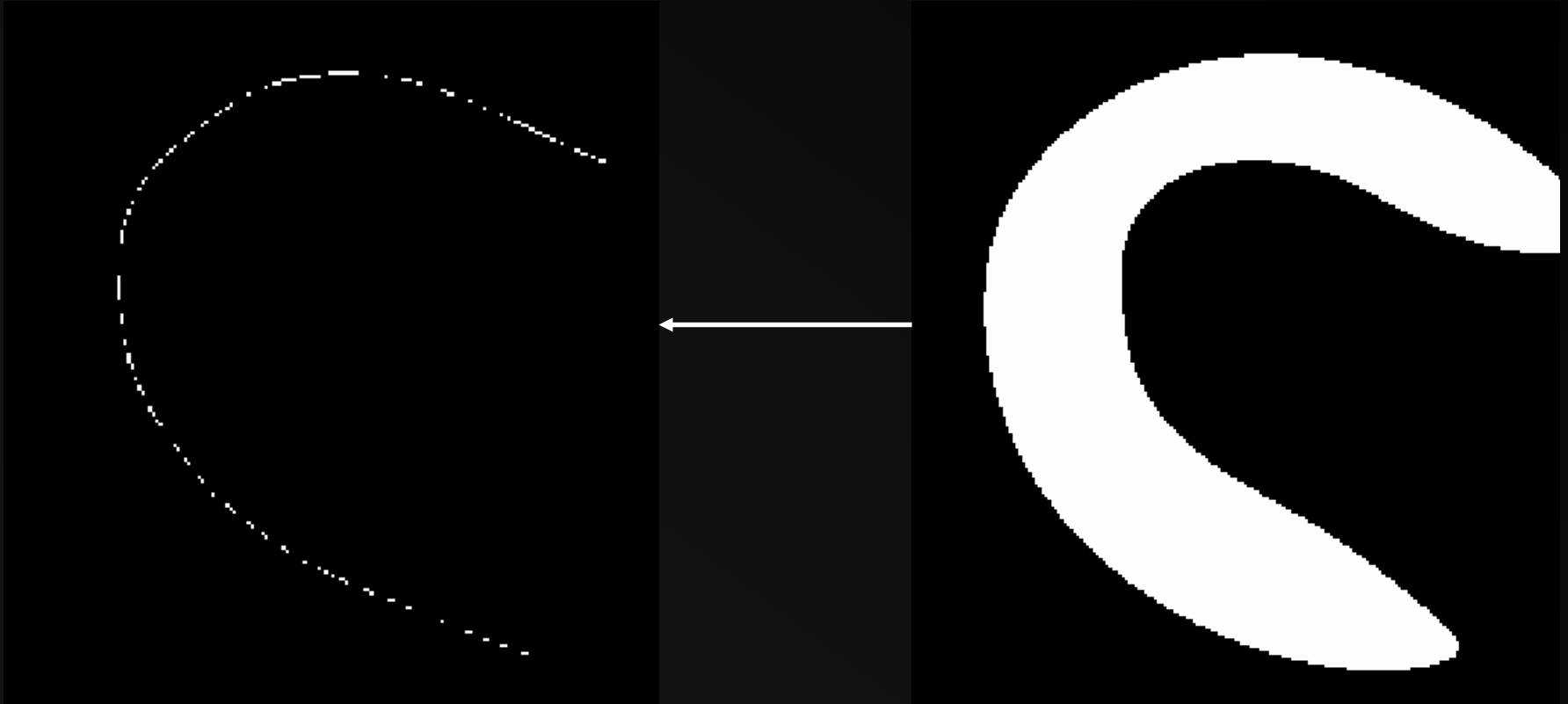


Skeletonizer

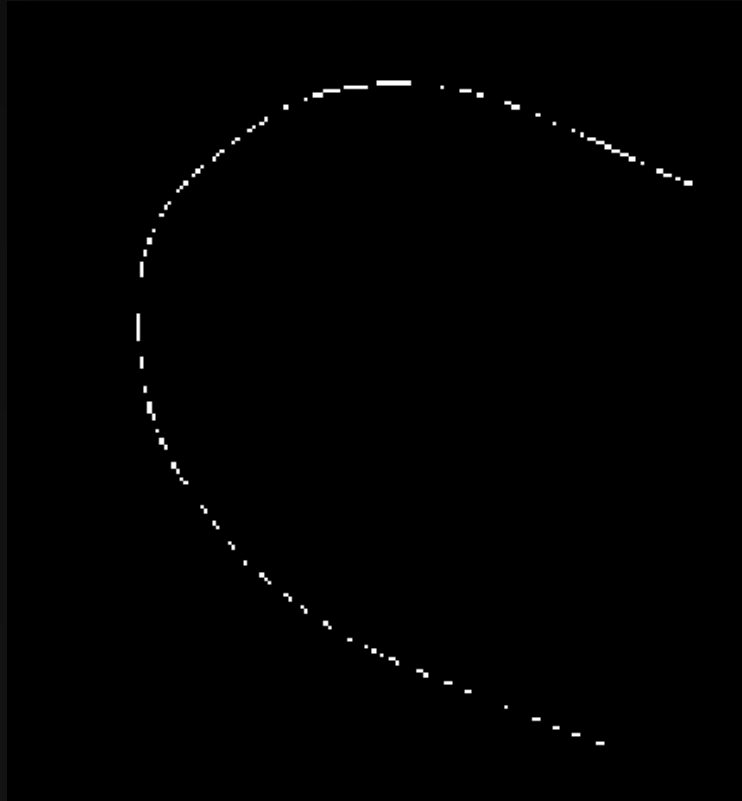


Stentiford's Algorithm: J. R. Parker. Algorithms For Image Processing and Computer Vision. John Wiley and Sons, Inc., 1997

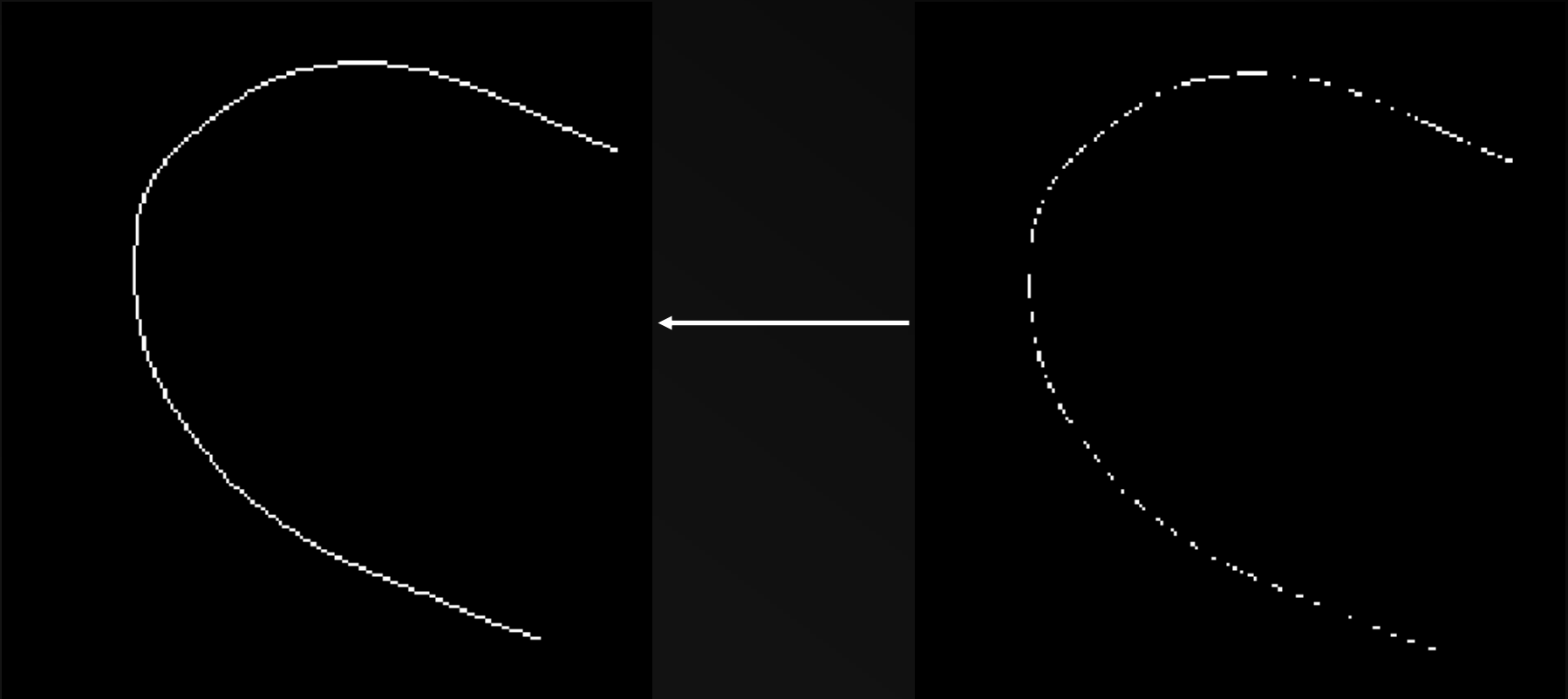
Skeletonizer



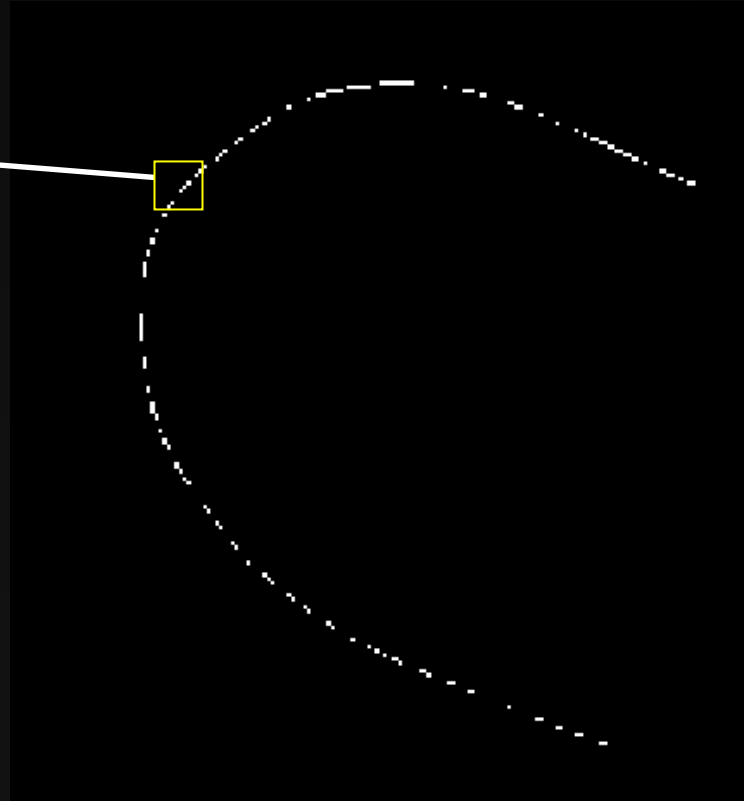
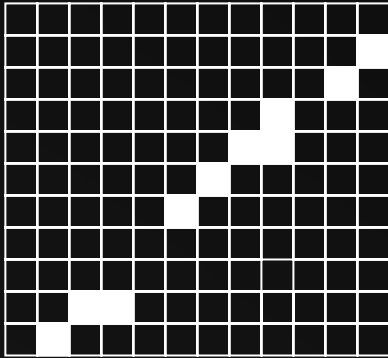
Closing Algorithm



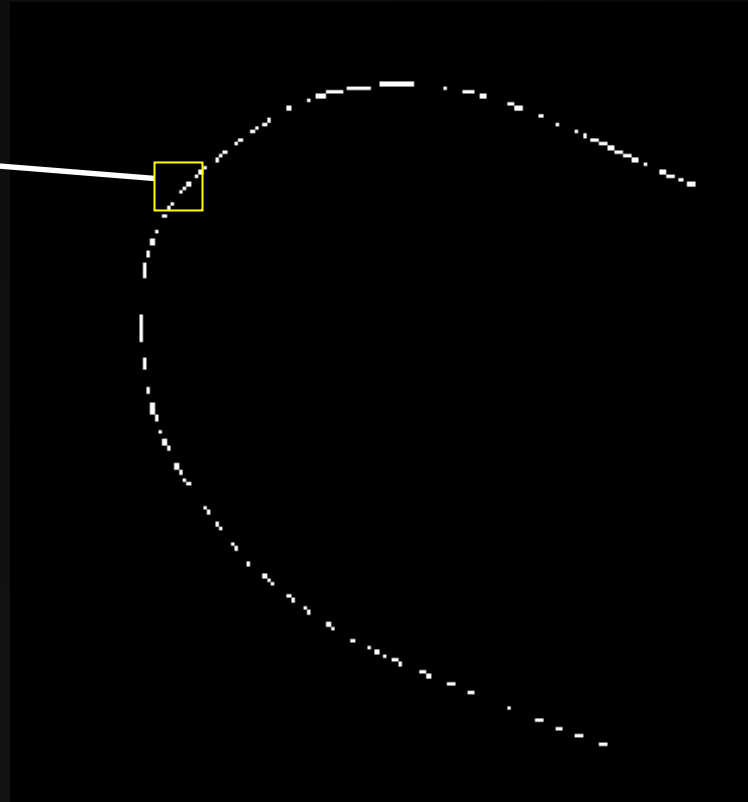
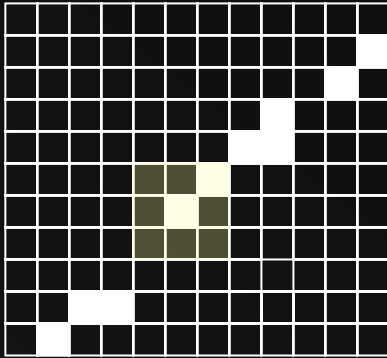
Closing Algorithm



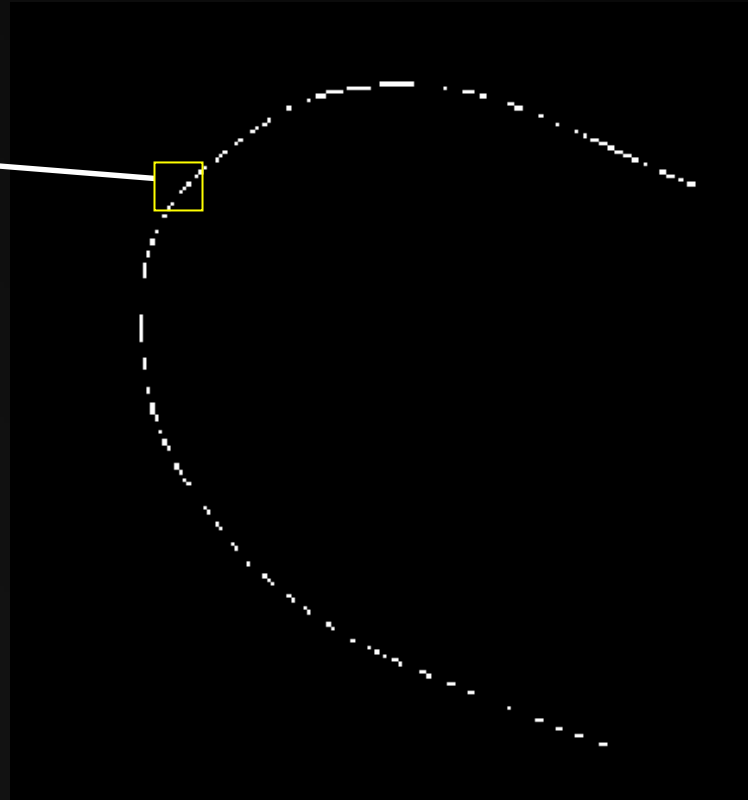
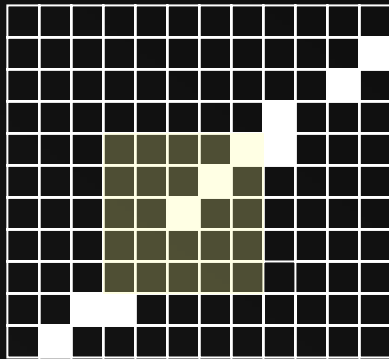
Closing Algorithm



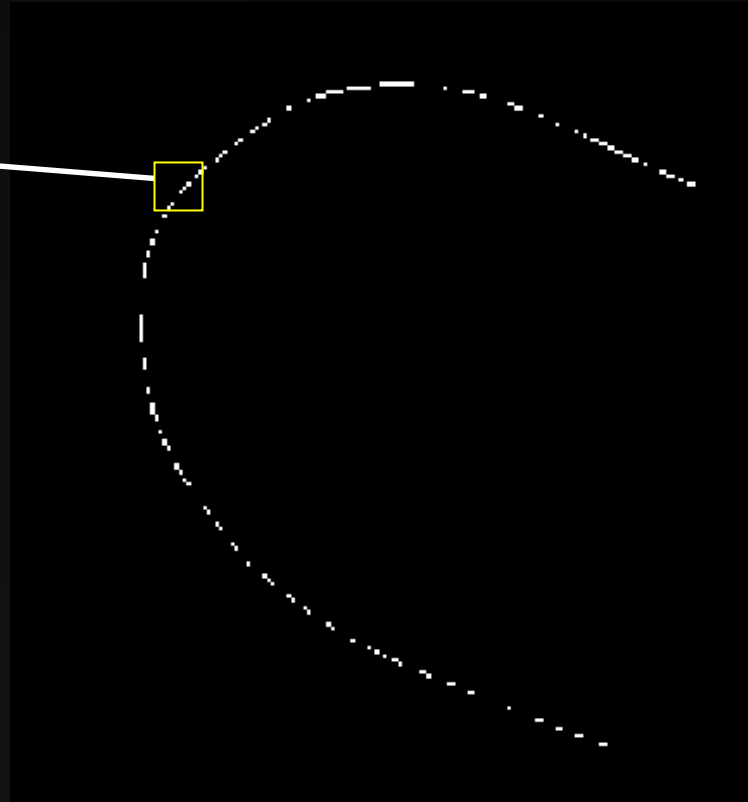
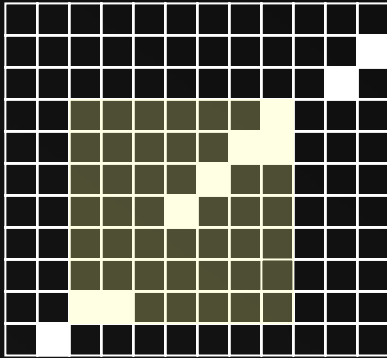
Closing Algorithm



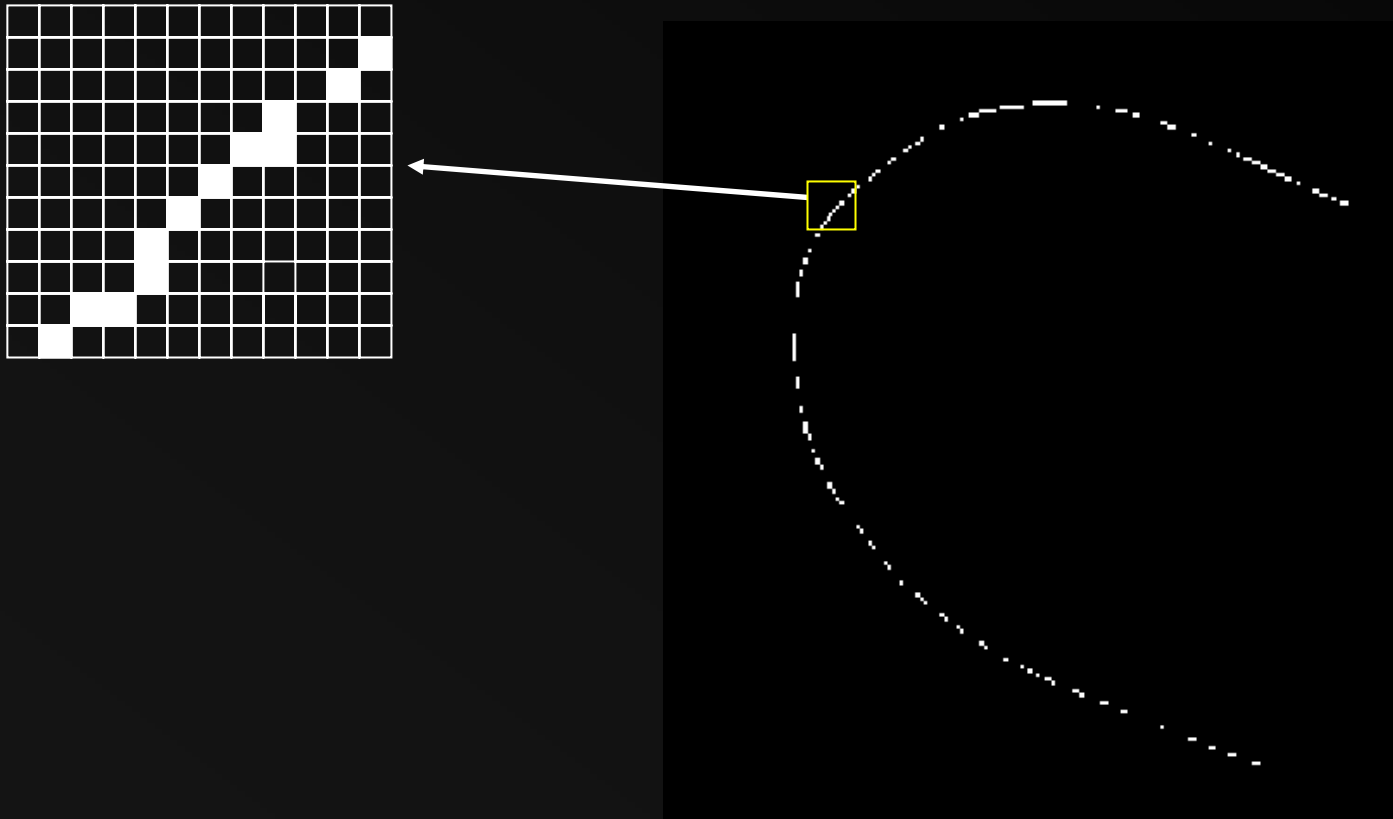
Closing Algorithm



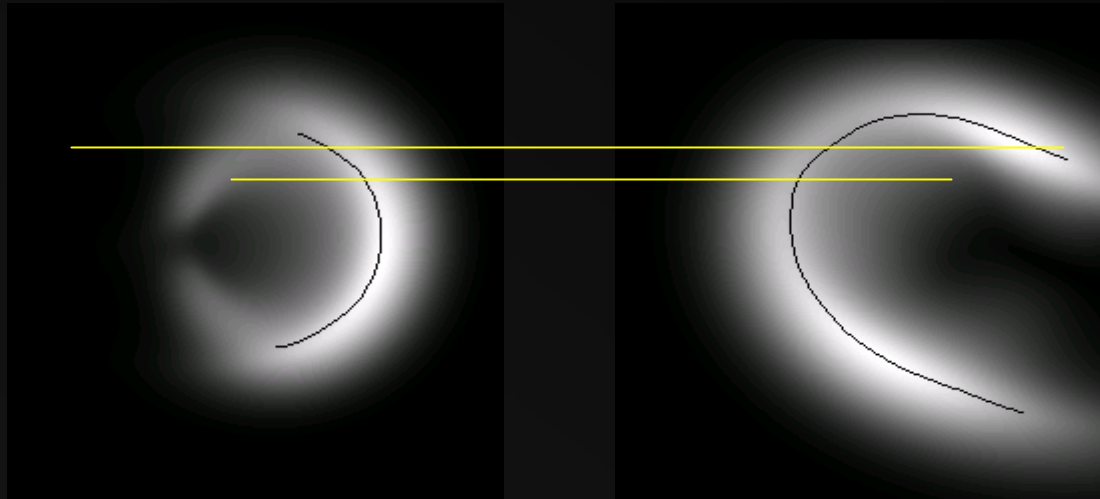
Closing Algorithm



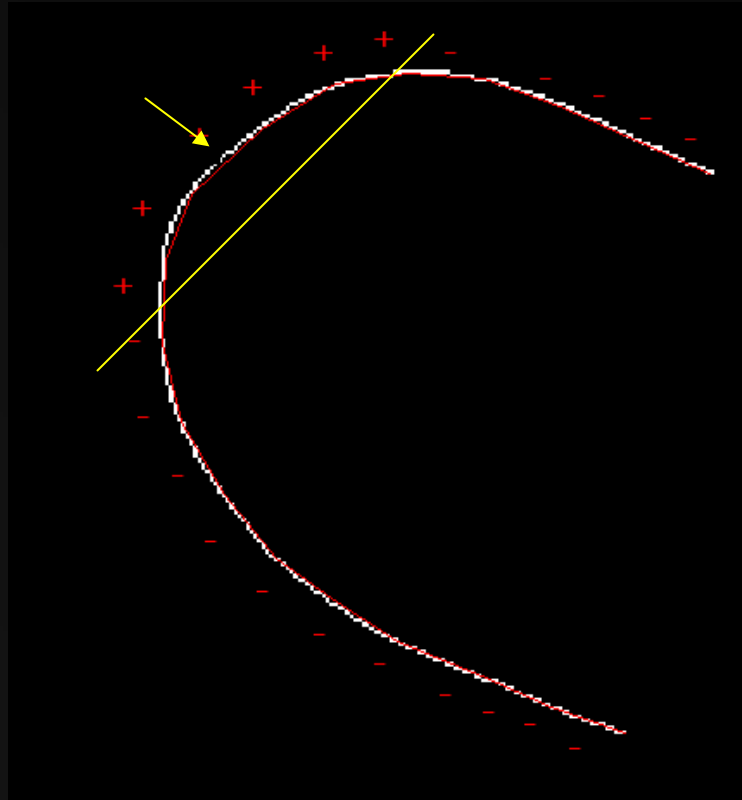
Closing Algorithm



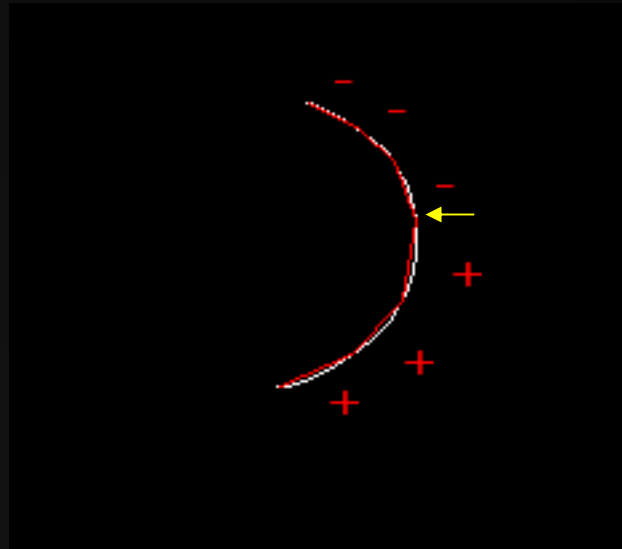
Horizontal Line



Slope Analyzer



Slope Analyzer



CME Representative Point

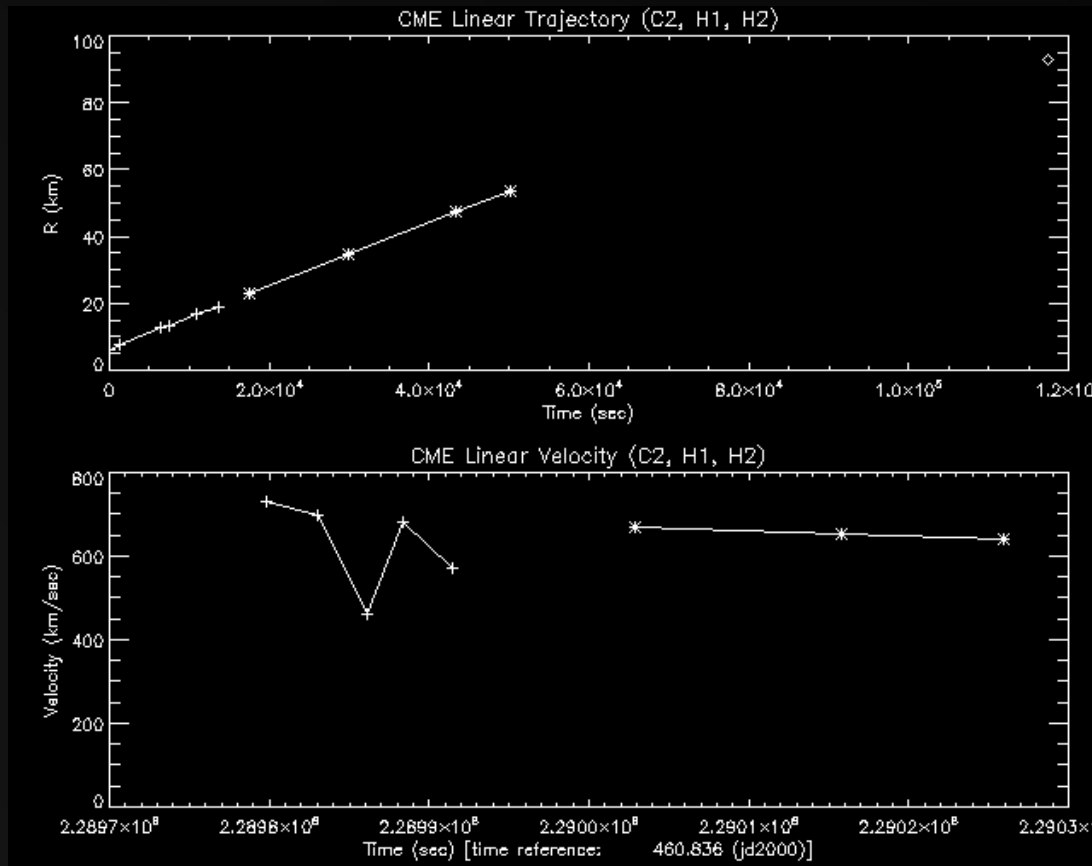
20080708_171042ph1B.xyz - emacs@tosca.jpl.nasa.gov

File Edit Options Buffers Tools Help

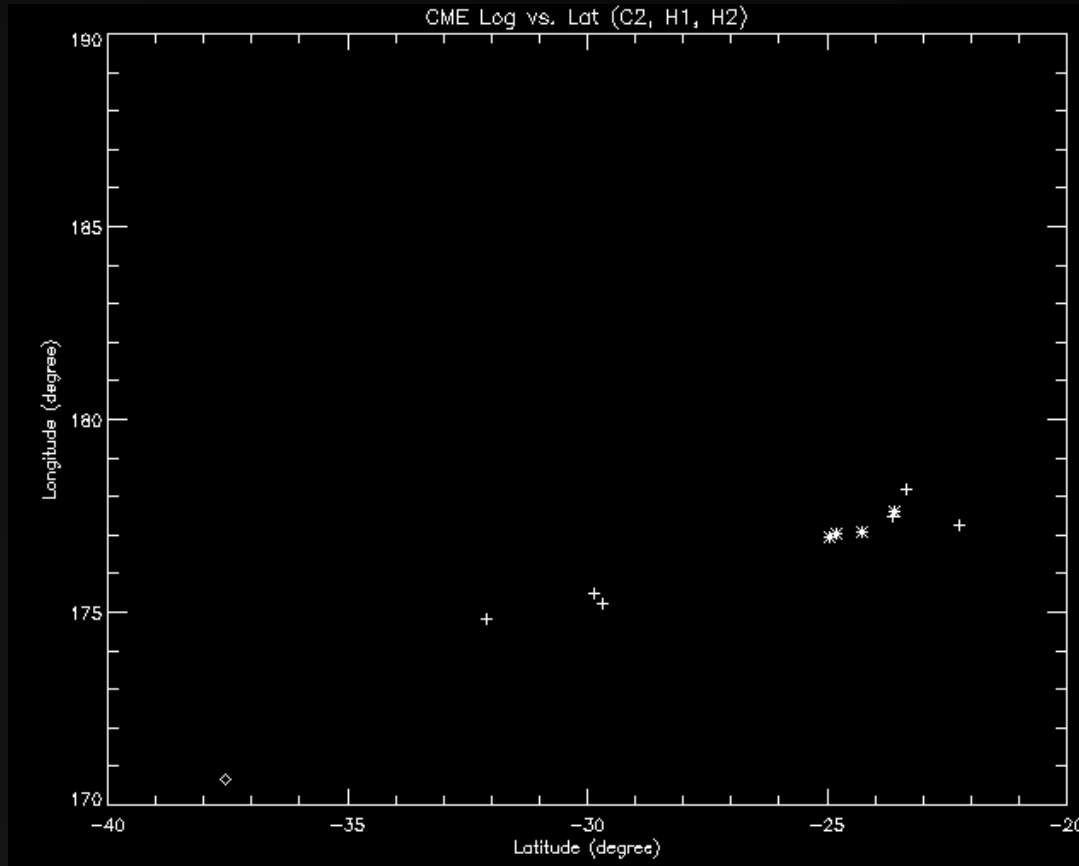
left_line	left_samp	right_line	right_samp	x (km)	y (km)	z (km)	error (km)	latitude	longitude	R/Rsun
143.000	8.552	144.760	251.000	-12287016.062	206047.115	-3096345.149	15163.380	-14.142	179.039	18.208
144.000	8.781	145.869	251.001	-12319590.568	171833.095	-3295386.866	13739.847	-14.974	179.201	18.325
145.000	9.000	146.951	250.999	-12351063.974	139793.618	-3491911.578	7237.666	-15.786	179.352	18.442
146.000	9.000	148.008	250.999	-12350959.838	139995.743	-3686553.331	2144.089	-16.618	179.351	18.520
147.000	9.000	149.067	250.762	-12371945.515	178902.847	-3881143.940	9337.286	-17.415	179.172	18.632
148.000	9.000	150.141	250.535	-12392078.734	216163.937	-4076953.955	13957.484	-18.208	179.001	18.746
149.000	9.000	151.234	250.400	-12404112.766	238427.673	-4274620.860	15514.421	-19.011	178.839	18.854
150.000	9.000	152.360	250.175	-12424120.991	275095.167	-4475186.597	10352.133	-19.805	178.732	18.978
151.000	8.905	153.529	250.064	-12420409.573	306813.066	-4679885.073	2614.723	-20.640	178.585	19.075
152.000	8.781	154.688	250.003	-12408171.499	334766.400	-4883314.626	12771.744	-21.475	178.455	19.165
153.000	8.552	155.793	249.981	-12377543.829	372283.862	-5083170.460	16095.530	-22.318	178.277	19.233
154.000	8.214	156.873	250.218	-12308073.644	383824.947	-5281078.519	12976.723	-23.213	178.214	19.251
155.000	7.938	157.941	250.348	-12257022.809	403937.050	-5477644.332	8159.056	-24.068	178.112	19.298
156.000	7.667	158.933	250.418	-12211969.210	433050.460	-5672633.898	1113.544	-24.902	177.969	19.357
157.000	7.366	160.041	250.462	-12165093.516	470694.266	-5867504.408	5735.258	-25.732	177.784	19.417
158.000	7.214	161.106	250.608	-12130216.319	469695.274	-6063618.255	12551.503	-26.542	177.783	19.496
159.000	7.071	162.191	250.696	-12101928.748	476681.290	-6261537.232	14994.322	-27.339	177.744	19.589
160.000	6.929	163.305	250.854	-12067415.027	472028.971	-6462170.866	13162.183	-28.151	177.760	19.679
161.000	6.786	164.465	251.008	-12033243.257	467439.068	-6667007.458	2981.120	-28.970	177.775	19.777

20080708_171042ph1B.xyz (Fundamental)--L27--All--

Plot: 3D Trajectory + Velocity



Plot: Longitude vs. Latitude



Acknowledgements

Special Thanks To:

- Mentor: Dr. Paulett Liewer
- Jeffery Hall
- Dr. Eric DeJong
- Richard Alvidrez

Thank you to the JPLUS for their funding and assistance in making this possible.