

2020 MathWorks 中国汽车年会

数据分析算法的企业应用集成

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内容概要

- 数据分析算法的应用部署
- 基于浏览器的 Web 应用程序共享 – MATLAB Web App Server
- 分析算法/应用的生产环境部署 – MATLAB Production Server

博世开发汽车测试数据分析和可视化平台

挑战

减少汽车测试台数据的处理所需时间和步骤

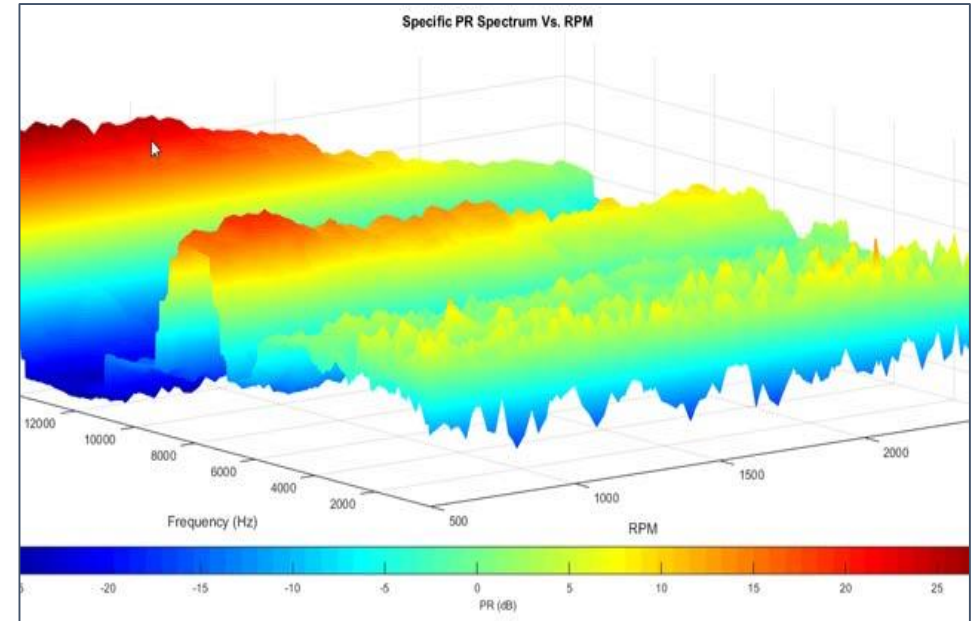
解决方案

使用 MATLAB 开发并部署一个数据分析和可视化平台，高效处理多域工程数据

结果

- 验证时间平均缩短 40–50%
- 节省3~4个月的研发时间
- 数据分析准确度提高

[Link to user story](#)



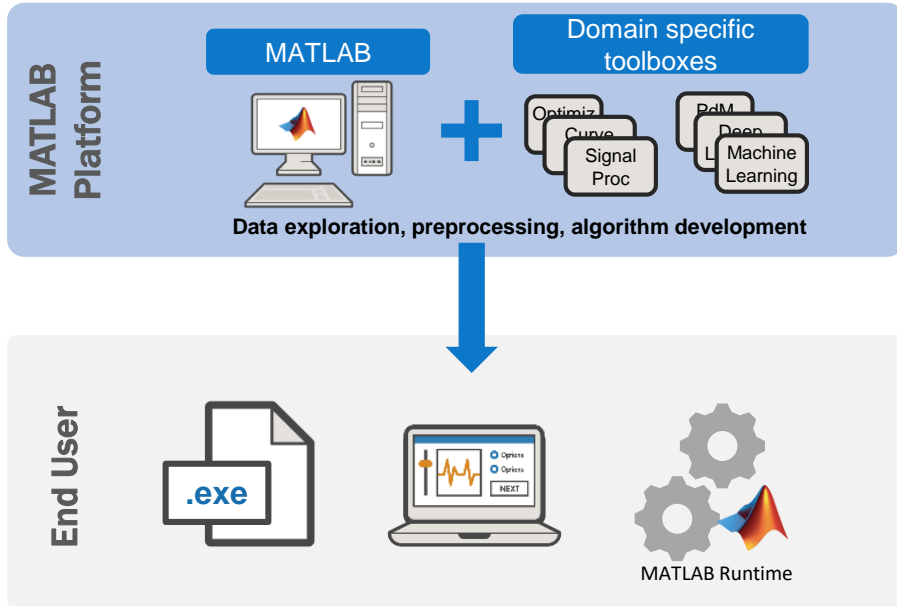
ENValyzer plot showing prominence ratio (PR) vs. RPM spectrum results. Prominence ratio is commonly used in acoustics data analysis.

“MATLAB enabled us to speed the development of ENValyzer, a customizable, easy-to-use tool for analyzing, visualizing, and interpreting engineering data in a wide variety of formats. Now, our engineers can validate components faster and more accurately than was possible with spreadsheets and third-party tools.”

- Sharath SL, Bosch

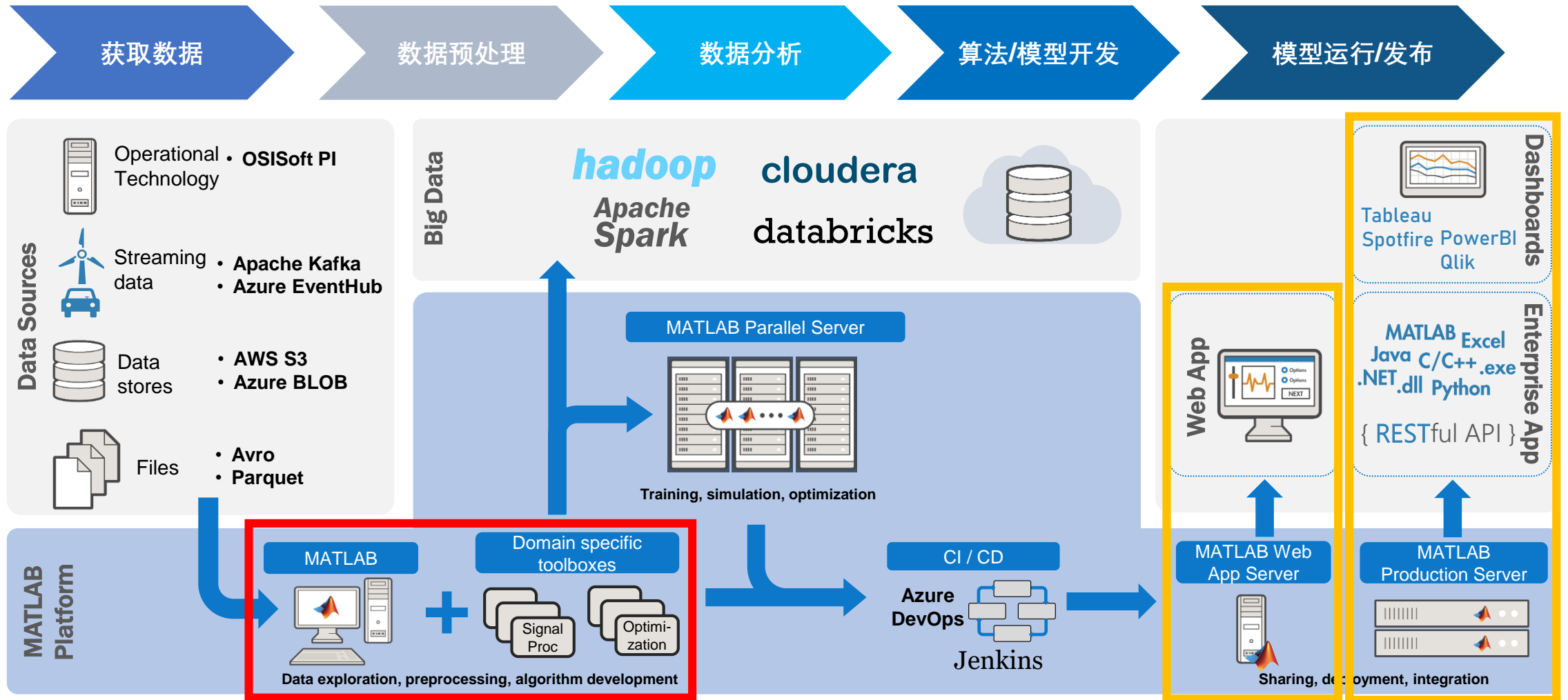
[Link to user story](#)

数据分析算法的应用部署

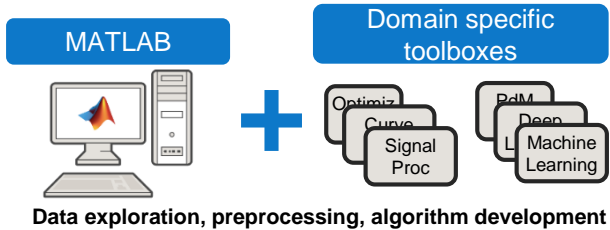


	独立可执行文件 (Compiler)
运行于 ...	PC
离线使用	✓
集中式托管	x
本地客户端应用程序	✓
	Algorithm/simulation is distributed to individual PC

MathWorks提供完整的端到端数据分析解决方案

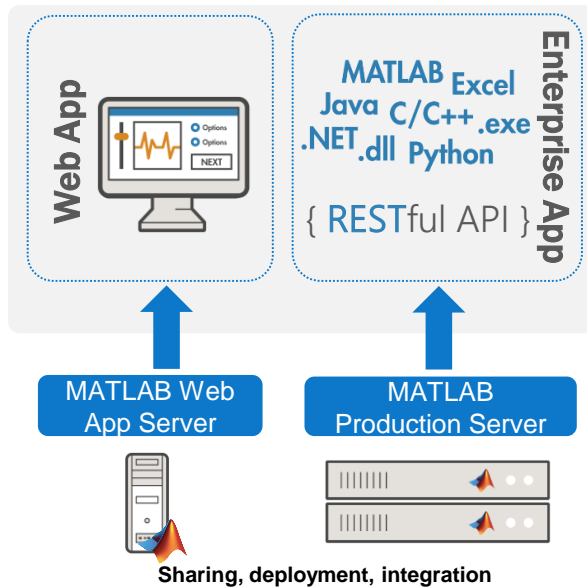


MATLAB数据分析算法的企业应用集成



应用场景： 车队大数据处理
 驾驶性量化评估
 驾驶风格分析
 数字孪生
 预测性维护

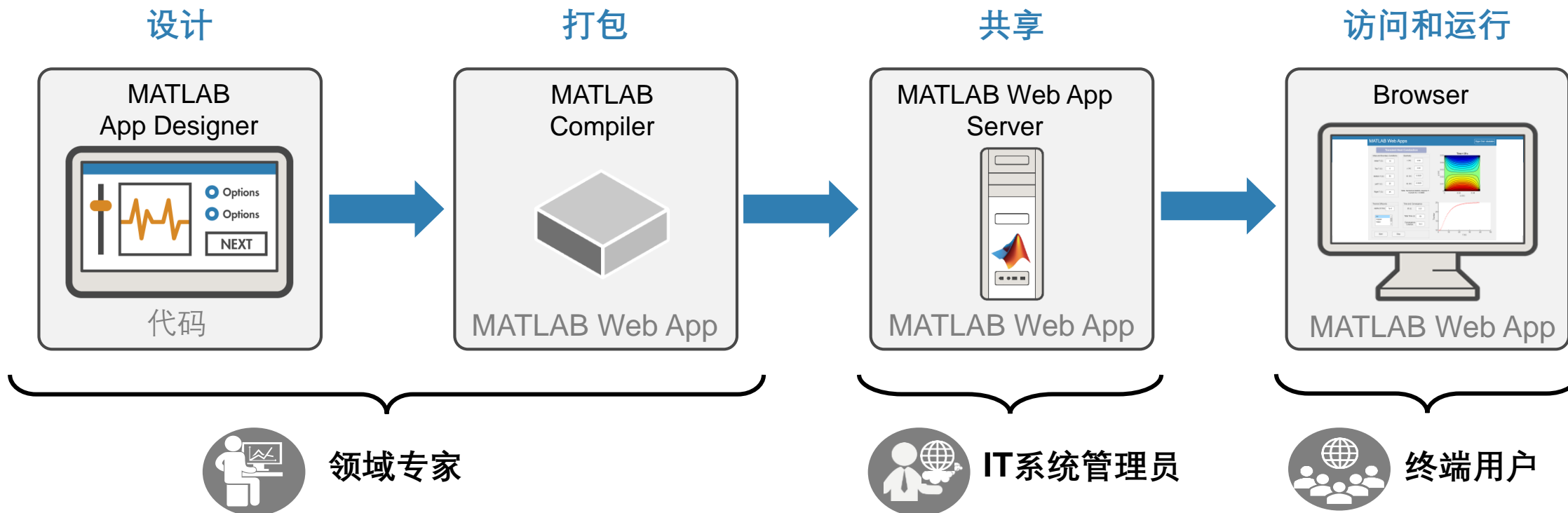
功能需求： 数据清洗、分析、挖掘
 大数据处理
 数据可视化
 预测模型（机器学习、深度学习）



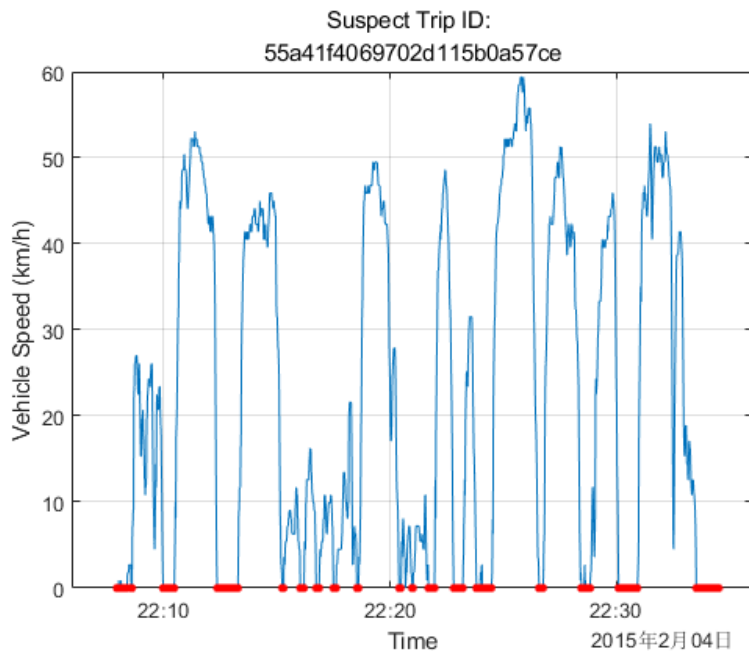
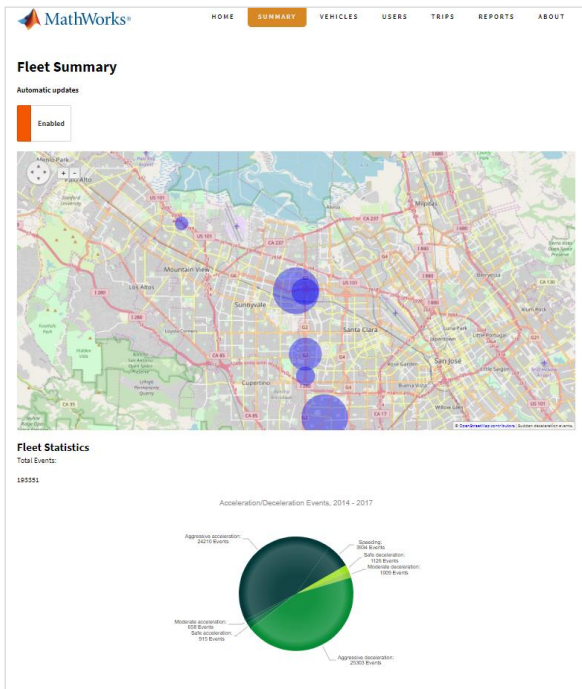
应用场景	MATLAB Web App Server	MATLAB Production Server
将使用App Designer开发的应用程序作为Web应用发布	✓	
与企业应用集成 (C/C++, Java, C#.NET, Python)		✓
与第三方网络应用集成, 例如HTML/Javascript, Angular, React, ASP.NET, JSP, RESTful 等等		✓
与移动端应用集成 (iOS, Android, Phonegap, Cordova)		✓
与流数据/智能物联网应用集成		✓

解决方案1: MATLAB Web App Server R2020a

将算法或仿真作为基于浏览器的 Web 应用程序共享



应用场景：车队大数据分析和可视化



Model Accuracy: 95.9%

HardBrake	212	19	4	0	1	1	0	0
MedBrake	15	262	57	0	4	0	0	0
LightBrake	3	46	591	3	7	3	0	0
Ok	0	1	36	7450	21	0	0	0
LightAccel	0	0	1	4	599	14	10	0
MedAccel	0	0	0	0	97	158	2	0
HiAccel	0	0	0	0	31	17	136	0
Speeding	1	0	1	6	2	1	0	184
	HardBrake	MedBrake	LightBrake	Ok	LightAccel	MedAccel	HiAccel	Speeding
Actual	Predicted							

示例：基于Web App Server的车队大数据可视化

设计

MATLAB
App Designer



代码

```
1 classdef FleetDataSource < matlab.mixin.SetGetExactNames
2     %FLEETDATASOURCE Application data model. Models are implemented as handle
3     %classes so that they can be referenced by multiple views.
4
5     properties ( SetAccess = private )
6
7         % Datastore
8         Datastore
9         % Summary
10        VINSummary = defaultLog(3);
11        % Summary
12        TripSummary = defaultLog(6);
13        % Summary
14        EventsSummary
15
16    end % properties ( SetAccess = private )
17
18    properties (Dependent, SetObservable)
19
20        % Start and end time of data to be observed.
21        TimeIntervalLimits
22        % Number of Trips
23        NumTrips
24        % Number of Vehicles
25        NumVehicles
26
27    end % properties (Dependent, SetObservable)
```

App开发

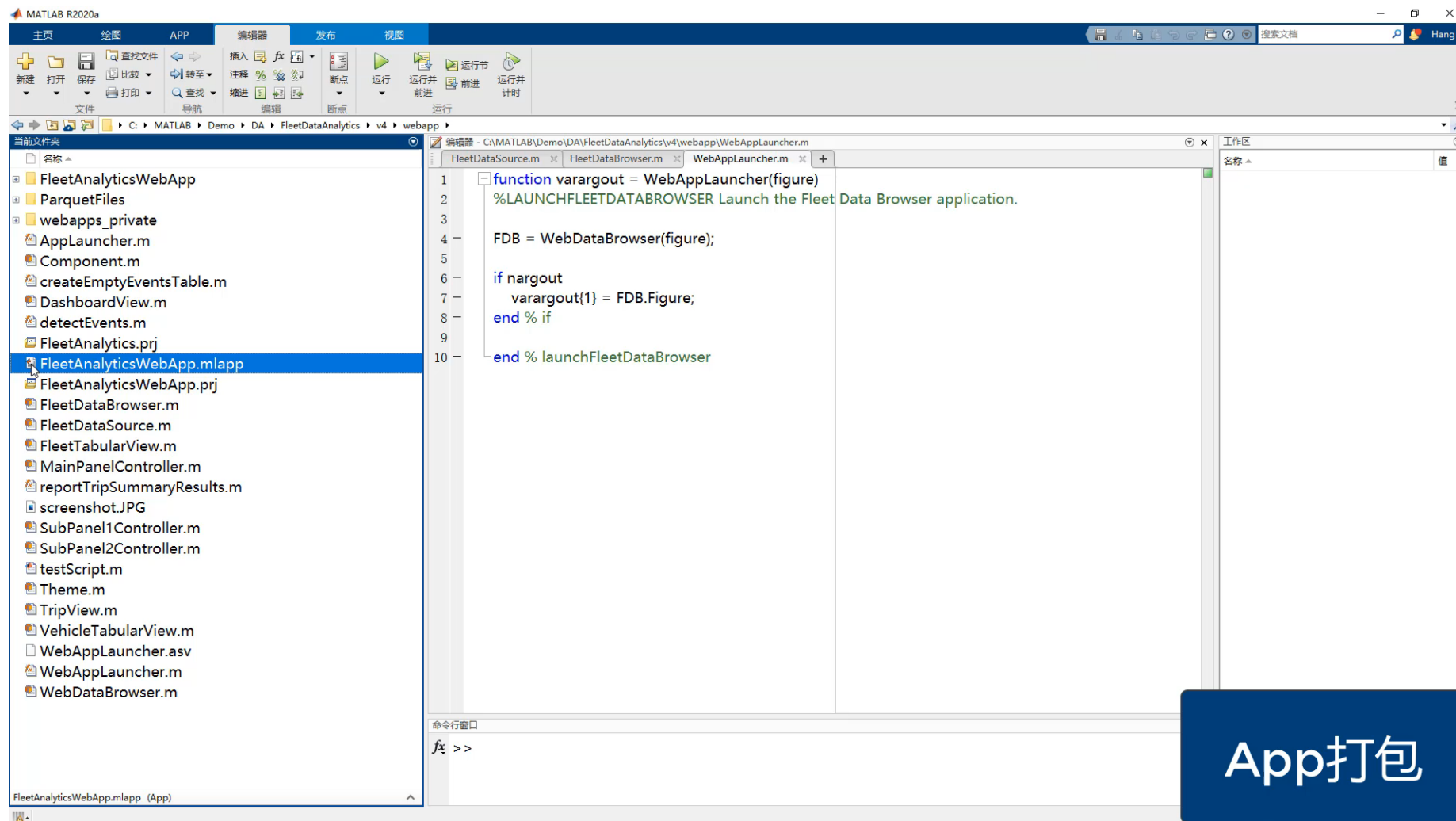
示例：基于Web App Server的车队大数据可视化

打包

MATLAB
Compiler



MATLAB Web App



The screenshot shows the MATLAB R2020a environment. The left pane displays a file browser with the following structure:

- 当前文件夹
 - 名称 ^
 - FleetAnalyticsWebApp
 - ParquetFiles
 - webapps_private
 - AppLauncher.m
 - Component.m
 - createEmptyEventsTable.m
 - DashboardView.m
 - detectEvents.m
 - FleetAnalytics.prj
 - FleetAnalyticsWebApp.mlapp**
 - FleetAnalyticsWebApp.prj
 - FleetDataBrowser.m
 - FleetDataSource.m
 - FleetTabularView.m
 - MainPanelController.m
 - reportTripSummaryResults.m
 - screenshot.JPG
 - SubPanel1Controller.m
 - SubPanel2Controller.m
 - testScript.m
 - Theme.m
 - TripView.m
 - VehicleTabularView.m
 - WebAppLauncher.asv
 - WebAppLauncher.m
 - WebDataBrowser.m

The right pane shows the code editor with the following MATLAB code:

```
1 function varargout = WebAppLauncher(figure)
2 %LAUNCHFLEETDATABROWSER Launch the Fleet Data Browser application.
3
4 FDB = WebDataBrowser(figure);
5
6 if nargin
7     varargout{1} = FDB.Figure;
8 end % if
9
10 end % launchFleetDataBrowser
```

The command window at the bottom shows the prompt `>>`.

App打包

示例：基于Web App Server的车队大数据可视化

共享























MATLAB Web App Server



MATLAB Web App

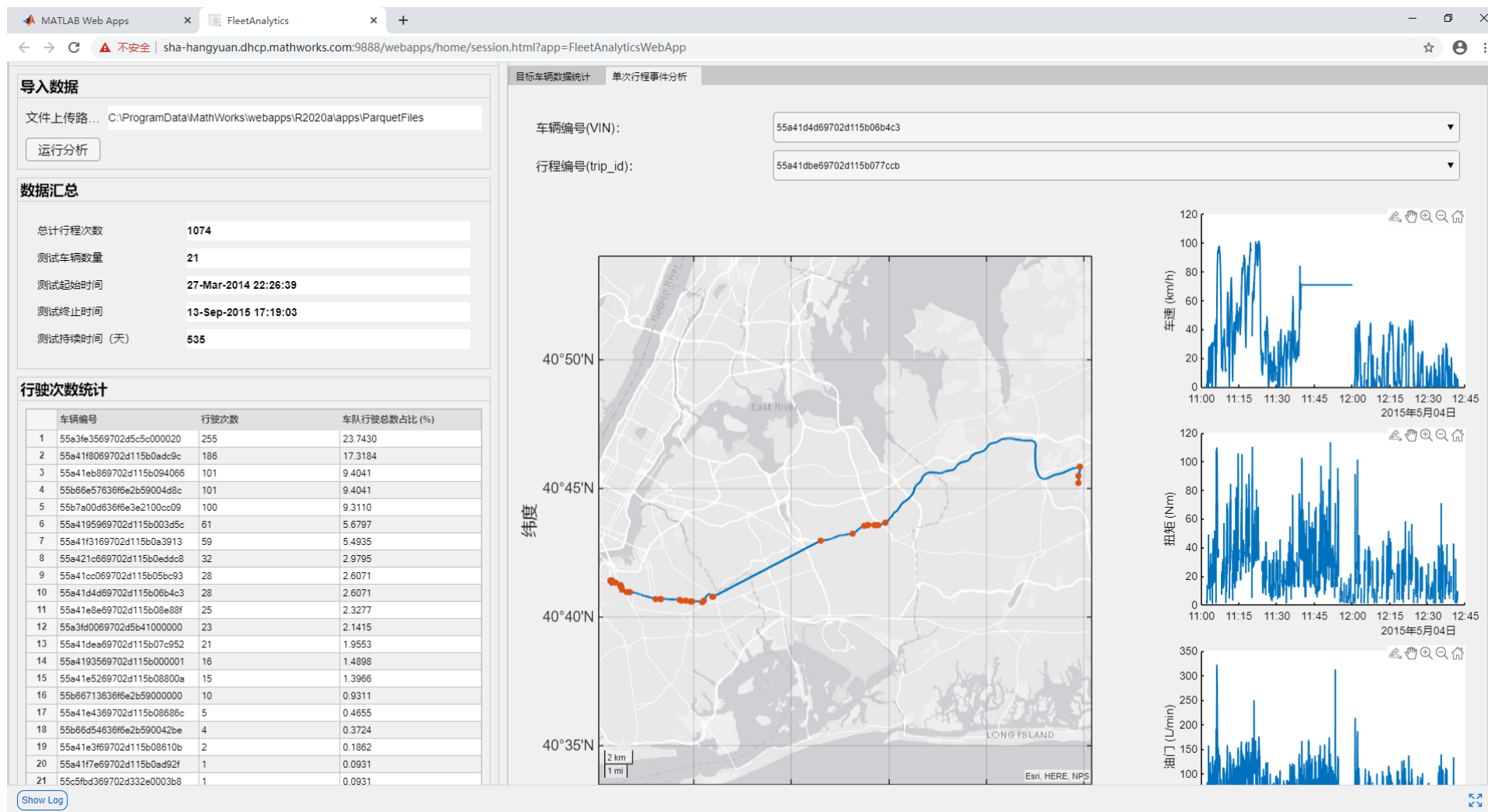
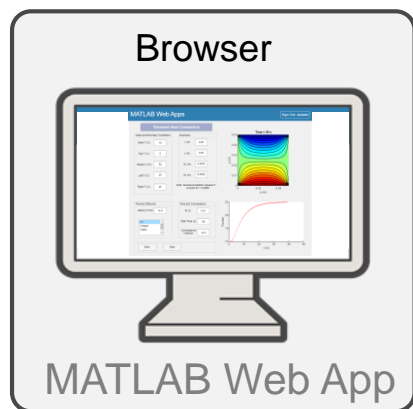
MATLAB Web Apps > Manage Apps

Upload App Sign Out: Suresh (Author)

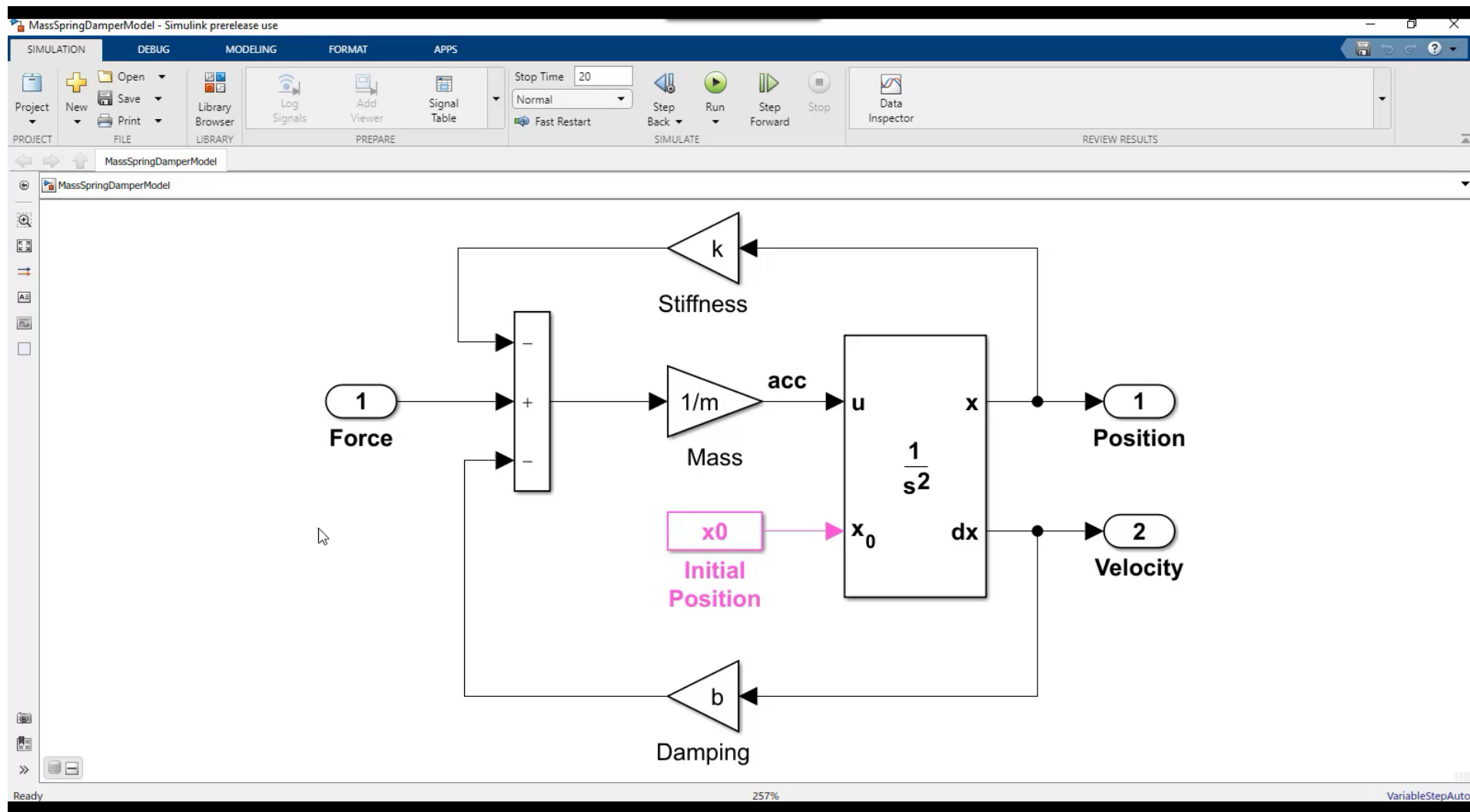
Name	Version	Author	MATLAB Runtime	Status Message	
 Mass Spring Damper	1.0	-	R2020a	✓ OK	
 MassSpringDamperAppForLinux		-		✗ Expired CTF	
 Mortgage	2.1	MATLAB AppDesigner Examples	R2020a	✓ OK	
 NFLPlayersApp	1.0	MATLAB Connector Team	R2020a	✓ OK	
 PatientsDisplay	1.0	MATLAB AppDesigner Examples	R2020a	✓ OK	
 PatientsTreeAppExample	1.0	MATLAB AppDesigner Examples	R2020a	✓ OK	
 PlotSelector	1.0	MATLAB Graphics Team	R2020a	✓ OK	
 PulseGenerator	1.0	MATLAB AppDesigner Examples	R2020a	✓ OK	
 RoadSuspensionInteractionIn3DOF_SLSimApp		-		✗ Expired CTF	
 TMDDsim	2.0	MathWorks SimBiology Team	R2019b	✓ OK	
 TransientConduction	1.0	Dave Garrison	R2020a	✓ OK	

示例：基于Web App Server的车队大数据可视化

访问和运行



支持将Simulink仿真部署为web应用

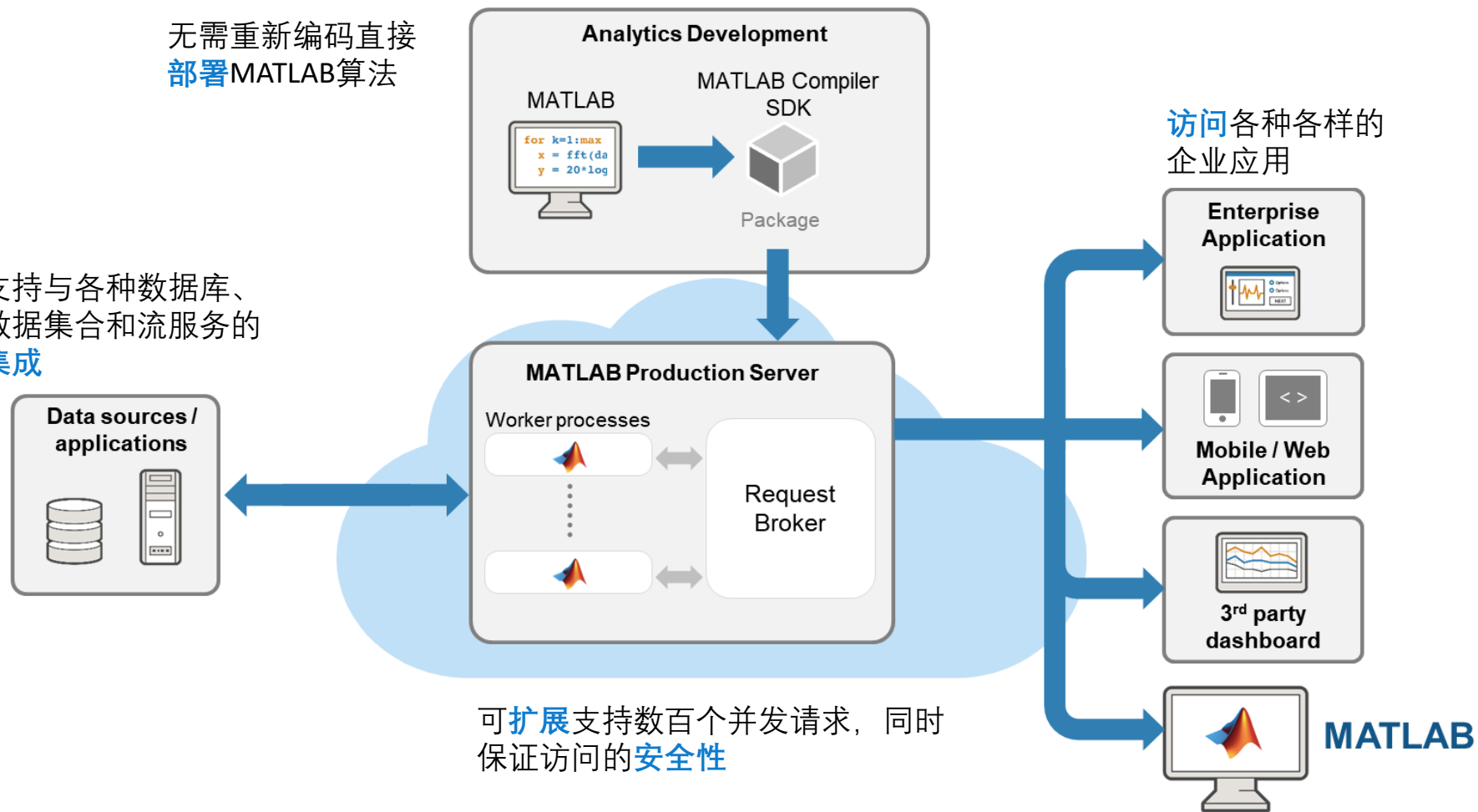


解决方案2: MATLAB Production Server

将模型或算法以 API 的形式与企业IT/OT系统集成

无需重新编码直接
部署MATLAB算法

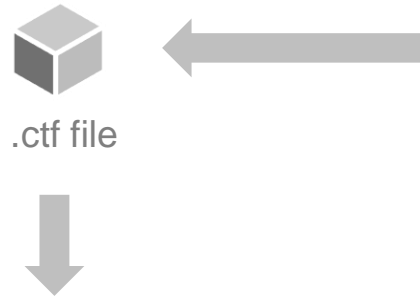
支持与各种数据库、
数据集合和流服务的
集成



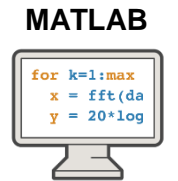
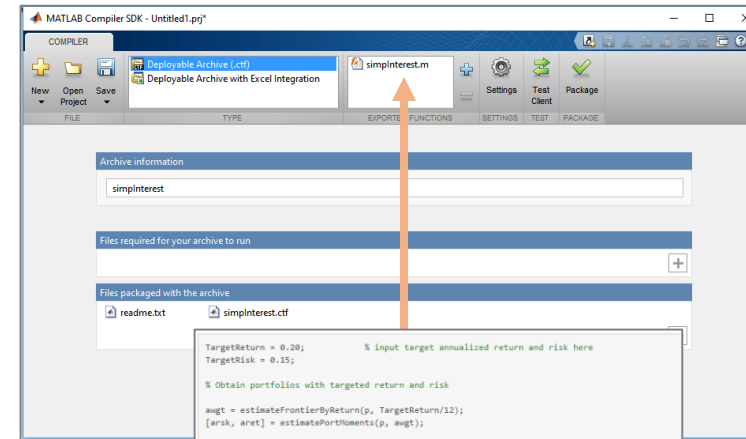
可扩展支持数百个并发请求，同时
保证访问的安全性

基本 workflow

Click the 'Package' button and wait for the compiler to generate the deployable archive



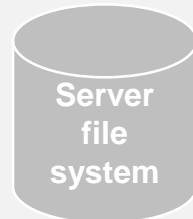
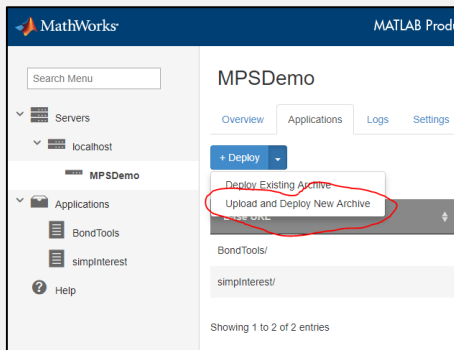
MATLAB Compiler SDK



Code / test

MATLAB Production Server

Copy .ctf file into the auto_deploy folder or use web dashboard



```
TargetReturn = 0.20; % input target annualized return and risk here
TargetRisk = 0.15;

% Obtain portfolios with targeted return and risk
augt = estimateFrontierByReturn(p, TargetReturn/12);
[arsk, aret] = estimatePortfolios(p, augt);

bmgf = estimateFrontierByRisk(p, TargetRisk/sqrt(12));
[brsk, bret] = estimatePortfolios(p, bmgf);

% Plot efficient frontier with targeted portfolios
clf;
portfolioexamples_plot('Efficient Frontier with Targeted Portfolios', ...
    {'line', prsk, pret}, ...
    {'scatter', [mrsk, crsk, ersk], [mret, cret, eret], {'Market', 'Cash', 'Equal'}}, ...
    {'scatter', arsk, aret, (sprintf('%5s Return', 10*TargetReturn))}, ...
    {'scatter', brsk, bret, (sprintf('%5s Risk', 10*TargetRisk))}, ...
    {'scatter', sqrt(diag(p.AssetCovar)), p.AssetMean, p.Assestist, ''});
```

MATLAB code

基本工作流程示例

- 封装算法svmPredict
- 将应用托管到MPS
- 通过MPS Dashboard管理
- 在MATLAB中发送请求

The screenshot displays the MATLAB R2020a environment with the following code sections:

```
读取测试数据
1 testFile = [pwd '\predictData\train_FD001_Unit_51.csv'];
2 testDs = datastore(testFile,'TreatAsMissing','NA','Delimiter',';');
3 predictorNames = {'LPCOutletTemp','HPCOutletTemp','LPTOutletTemp',...
4 'TotalHPCOutletPres','PhysFanSpeed','PhysCoreSpeed',...
5 'StaticHPCOutletPres','FuelFlowRatio','CorrFanSpeed',...
6 'CorrCoreSpeed','BypassRatio','BleedEnthalpy',...
7 'HPTCoolantBleed','LPTCoolantBleed'};
8
9 testDs.SelectedVariableNames = predictorNames;
10 tempdata = read(testDs);

数据预处理
11 filterWindow = 5;
12 testData = filterNoisePredict(tempdata,predictorNames,filterWindow);

向MPS发送请求
13 baseUrl = 'http://localhost:9910/svmPredict';
14 service = 'svmPredict';
15 dataRecordNum = 178;
16 url = [baseUrl '/' service];
17 data = {};
18 data{1} = testData(dataRecordNum,:);
19 % 将输入数据封装为json格式，MPS支持以json格式的输入数据
20 jsonData = mps.json.encode(request(data));
21 options = weboptions('ContentType','json','MediaType','application/json','Timeout',200);

发送post请求
22 ret = webwrite(url,jsonData,options)

23 % discoveryURL = 'http://localhost:9910/api/discovery'
24 % service = webread(discoveryURL)
```

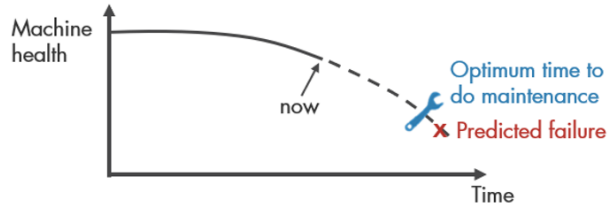
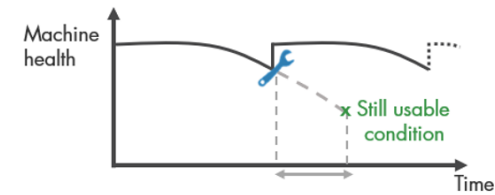
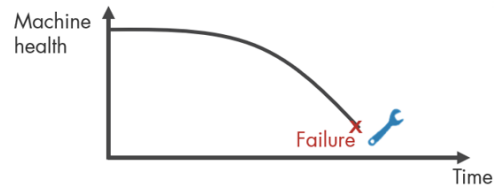
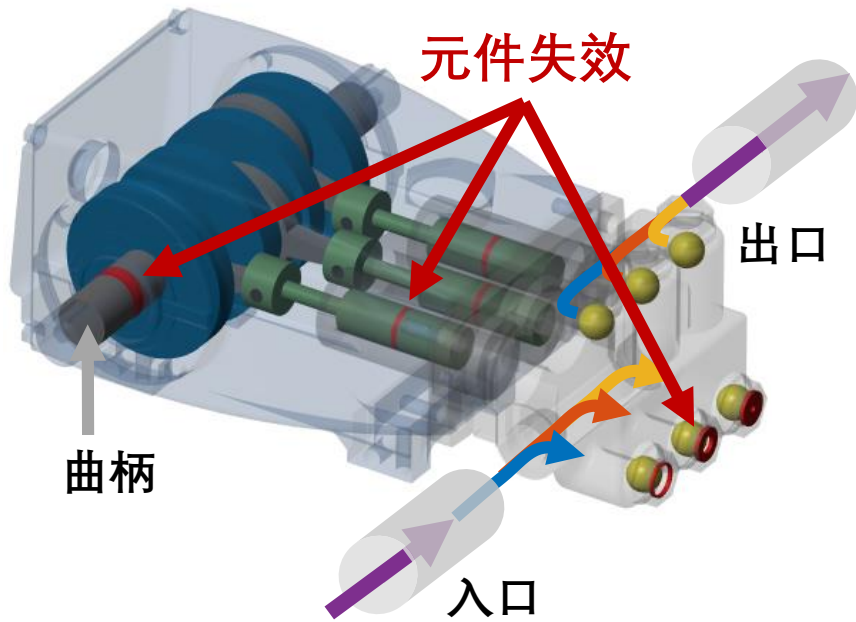
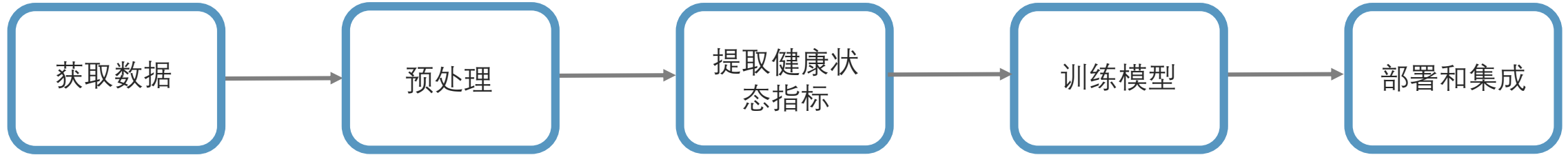
命令窗口: `fx >>`

右侧工作区变量列表:

- baseUrl
- data
- dataRecordNum
- discoveryURL
- filterWindow
- jsonData
- options
- predictorNames
- ret
- service
- tempdata
- testData
- testDs
- testFile
- url

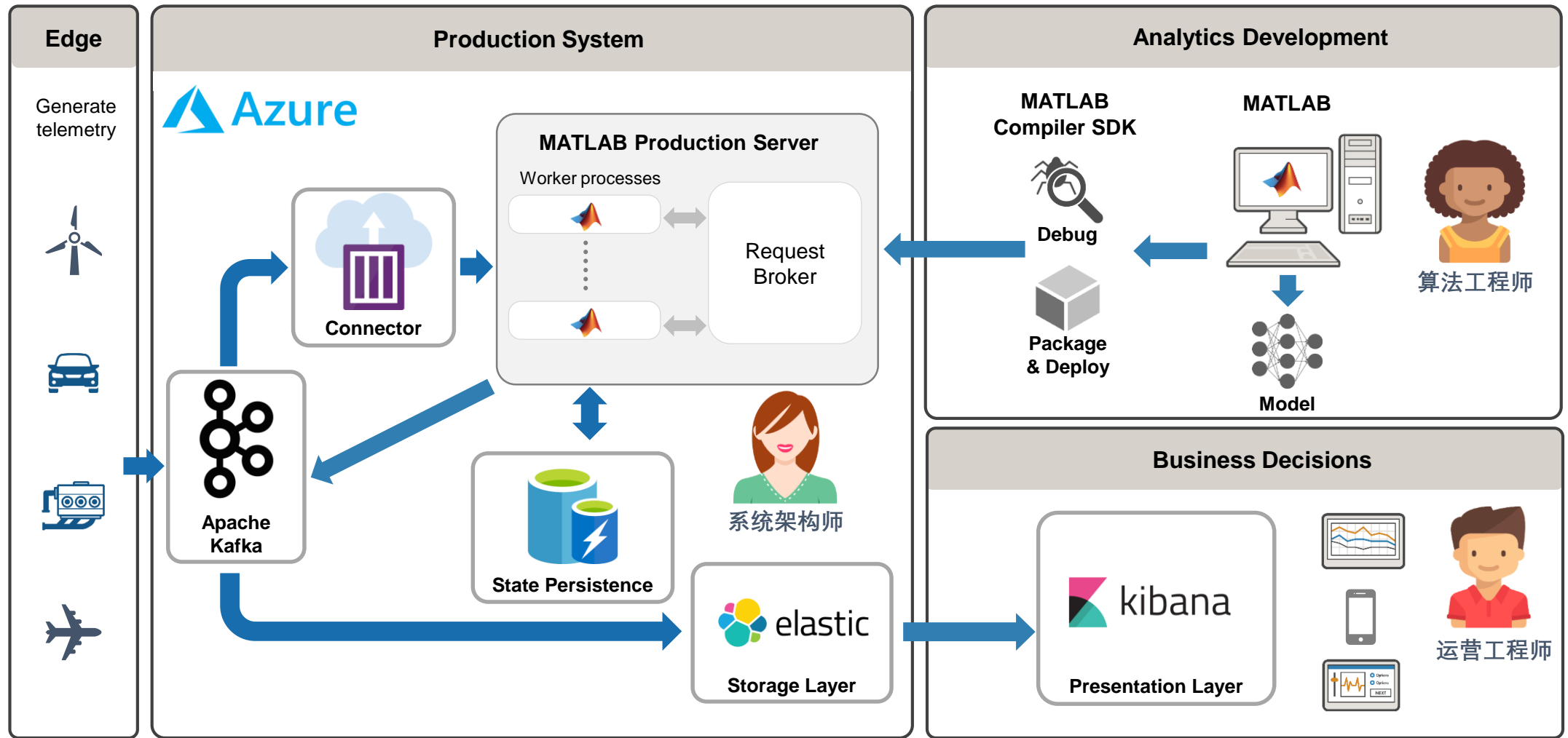
查看预测函数

应用场景：物理设备数字孪生与预测性维护



Actual leak fault	None	43	0	8	0	0	0	0	0	
	Leak	0	13	1	5	0	0	0	0	
	Blocking	11	0	25	0	0	0	0	0	
	Leak & Blocking	0	8	0	5	0	0	0	0	
	Bearing	0	0	0	0	11	0	17	0	
	Bearing & Leak	0	0	0	0	1	6	0	5	
	Bearing & Blocking	0	0	0	0	11	0	14	0	
	All	0	0	0	0	0	10	0	6	
		Predicted fault								
		None	Leak	Blocking	Leak & Blocking	Bearing	Bearing & Leak	Bearing & Blocking	All	

系统架构



示例：基于Kafka流数据的三缸泵近实时异常检测和预测性分析

The screenshot displays the MATLAB R2020a Simulink environment. The main workspace shows a Simulink model titled "Triplex Pump with Faults". The model consists of several interconnected blocks: a "Motor" block connected to a "Pump" block, which is connected to an "Input Manifold" block. The "Input Manifold" block has three output ports labeled "Out1", "Out2", and "Out3". These outputs are connected to three parallel "q,p" blocks, which are then connected to a "Load" block. The "Load" block has two ports labeled "A" and "B". Below the "Load" block, there are "Flow" and "Fluid Properties" blocks. The "Flow" block has two ports labeled "qIn" and "qOut". The "Fluid Properties" block is connected to the "Load" block. The workspace on the right side of the screen shows a list of variables and their values, including "ans" (2x5 table), "bearing" ([0;0;0]), "bearing_fa..." (3.0000e-...), "bearing_fa..." (0), "bearing_vi..." (1.0000e-...), "block" ([0.8000;0]), "block_in_fa..." (0.8000), "block_in_fa..." (1), "chkv_in_m..." (1.0000e-...), "data" (4x1 cell), "keyType" (1x1 Class), "kprod" (1x1 MATL...), "leak" ([1.0000e-...]), "leak_cyl_ar..." (5.0000e-...), "leak_cyl_ar..." (1.0000e-...), "mydir" ('Streamin...'), "noise_seed..." (0), "prodp" ('Streamin...'), "pump" (4x1 string), "smiData" (1x1 struct), "TRP_Par" (1x1 struct), and "valType" (1x1 Class). A blue button at the bottom right of the workspace area contains the text "创建数字孪生".

上海电气构建和部署成本节约型企业软件用于规划和设计分布式能源系统

挑战

开发可通过 Web 访问的软件用于规划和设计分布式能源系统

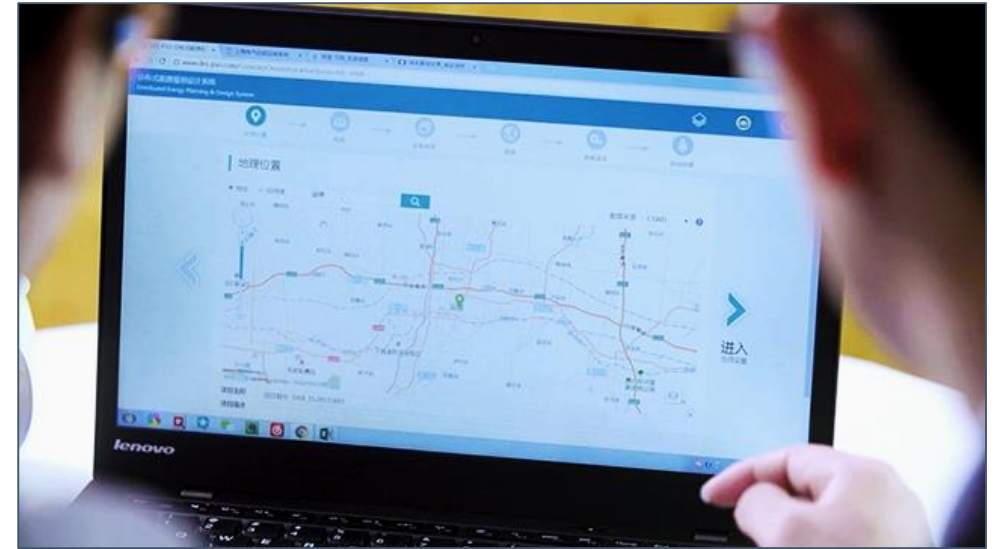
解决方案

使用 MATLAB 开发基于能源生产子系统、负载和电网的模型计算投资回报的算法，然后使用 MATLAB Production Server 在生产 IT 系统中部署算法

结果

- 交付时间缩短6个月
- 单个项目节省200万人民币
- 部署更新可即时获取，无需IT支持

[Link to user story](#)



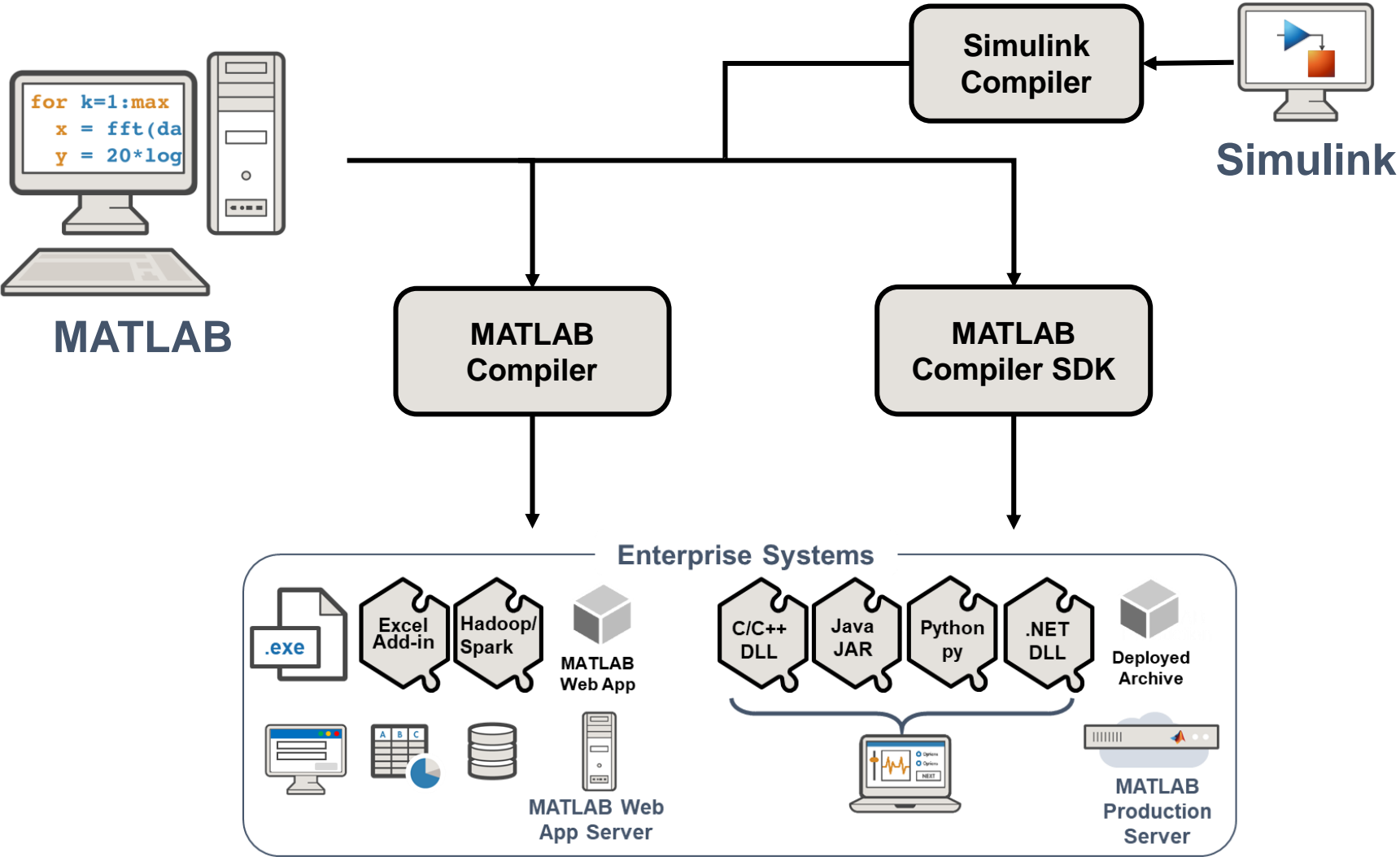
DES-PSO平台用户接口

“我的团队的专长是能源建模或算法开发，而不是将软件部署到生产环境。MATLAB 为我们节省了数月的模型和算法开发时间，并让我们能够轻松将其部署为稳定、可靠的 Web 应用程序的一部分，而无需重新编码。”
- 古云蛟, 上海电气

如何在不同部署方案间作出选择？

	独立可执行文件 (Compiler)	Web App (Web App Server)	Service API (Production Server)
运行于 ...	PC	Server	Server
离线使用	✓		
集中式托管		✓	✓
本地客户端应用程序	✓ Algorithm/simulation is distributed to individual PC		✓ Calls centrally managed algorithm/simulation
浏览器网页访问		✓ MATLAB Web App GUI	✓ With 3P web app e.g. HTML/Javascript
支持多版本MATLAB (运行时)		✓	✓
安全性 (身份验证)		✓ (LDAP, OpenID Connect)	✓ (x.509, Azure AD, Kerberos)
安全性 (访问控制)		✓ (LDAP, OpenID Connect)	✓ (x.509, Azure AD)

数据分析的企业应用集成工具链支持



Q & A