

Multiwell Retrospective Testing = MRT

Specific type of [Production Analysis \(PA\)](#) workflow based on correlation between multi-well [production/injection history](#) and [bottomhole pressure](#) history from [permanent downhole gauges \(PDG\)](#).

The key simulation engine of [MRT](#) is [Pressure Convolution](#) which is based on [Unit-rate Transient Responses \(UTR\)](#) retrieved from [Production rates / PDG](#) data history by means of [Pressure Deconvolution](#).

It does not require new data acquisition at well site and makes use of historical dynamic data records, usually few months or longer.

Motivation

Production rate in [producing well](#) depends on its [productivity index](#) J , current [formation pressure](#) p_e and current [BHP](#) p_{wf} :

$$(1) \quad q_1^\uparrow(t) = J \cdot (p_e(t) - p_{wf}(t))$$

and as such depends on [completion/lift](#) settings (defining $p_{wf}(t)$) and how [formation pressure](#) is maintained $p_e = p_e(t)$ over time.

It keeps declining due to the [offtakes](#):

$$(2) \quad p_e(t) = p_e[q_1^\uparrow(t), q_2^\uparrow(t), q_3^\uparrow(t), \dots]$$

and maintained by either aquifer or [Fluid Injection](#) and in the latter case depends on [injection rates](#):

$$(3) \quad p_e(t) = p_e[q_1^\downarrow(t), q_2^\downarrow(t), q_3^\downarrow(t), \dots]$$

The combination of (1), (2) and (3) lead to the correlation between [production rates](#), [injection rates](#) and [bottomhole pressure](#) variation.

The ultimate purpose of [MRT](#) is to extract maximum information from correlation between the long-term (few months or longer) [flowrate](#) history and [BHP](#) history (recorded by [PDG](#)).

It is essentially based on the fact that [BHP](#) in a given [well](#) (whether [producing](#) or [injecting](#)) responds to [flowrate](#) variation in the same [well](#) and may (or may not) respond to [flowrate](#) variation in offset [wells](#).

This information is further related to [well flow performance](#) and [cross-well connectivity](#).

Goals & Objectives

- Create short-term prediction model on production response to various multi-well production regimes

- Compare the well dynamics and cross-well connectivity with expectations and identify the candidates for drilling, workover or additional well surveillance
- Assess dynamic reservoir properties

Outputs

Production History	
	Simulated total subsurface flowrate history, $q_i(t)$
	Simulated BHP history, $p_{wf}(t)$
	Simulated formation pressure history, $p_e(t)$
	Simulated Productivity Index history, $J_i(t)$
	Simulated Cross-well interference history , $p_{k \rightarrow m}(t)$
Production Forecast	
	Rate forecast under Pressure Control regime, $p_k(t), \{q_m(t)\} \rightarrow q_k(t)$
	BHP forecast under Liquid Control regime, $\{q_m(t)\} \rightarrow p_{wf,k}(t)$
	Formation pressure forecast under Liquid Control regime, $\{q_m(t)\} \rightarrow p_{e,k}(t)$
Diagnostic Metrics	
	Cross-well interference map
	Unit-rate Transient Response Matrix (UTRM)
	Unit-rate Transient Response Spider (UTRS)
	Material Balance Pressure Plot
	Inflow Performance Relationship (IPR)
	Cumulative Productivity Plot (Hall Plot)
	J-plots
	WOR diagnostics
	GOR diagnostics
Primary Well & Reservoir properties	
	Potential drainage volume
	Current dynamic drainage volume
Secondary Well & Reservoir properties	
	Apparent transmissibility

	Apparent skin-factor
	Fracture half-length
	Dynamic fracture pressure threshold

Inputs

Primary Inputs	
	PVT model
	Production/injection history for all wells in a test
	Bottom-hole pressure (BHP) history for at least one well
Additional Inputs	
	Well locations map
	Well schematic
	Surface Well Tests
	Drilled formation pressure, p_d from DST – Drill Stem Test
	Drilled formation pressure, p_d from WFT – Wireline Formation Test
	Production Logging Reports
	Cased-Hole Pressure Transient Test Reports
	SGS – Static Gradient Survey Reports
	Well Intervention History

Applications

Production forecasts	
	Predict formation pressure without shutting wells down and avoiding production deferment
	Short-term production forecasts for different multi-well production scenarios
Selecting well-intervention candidates	
	Identify well-intervention candidates with possible thief production/injection
	Identify well-intervention candidates with possibly inefficient reservoir flow profile

	Identify well-intervention candidates for Rate Optimization
	Identify well-intervention candidates for producer injector conversion
Dynamic Model Calibration	
	Adjusting historical production allocation
	Adjusting the potential reservoir volume extension at different directions
	Adjusting faults / channels / compartmentalization
	Adjusting fracture model

Workflow

[MRT @workflow](#)

Examples

[MRT @sample](#)

See Also

[Petroleum Industry](#) / [Upstream](#) / [Production](#) / [Subsurface Production](#) / [Field Study & Modelling](#) / [Production Analysis](#)

[[MRT @sample](#)] [[MRT @workflow](#)]

[[Permanent downhole gauges \(PDG\)](#)] [[Pressure Convolution](#)] [[Pressure Deconvolution](#)] [[Multiwell Deconvolution \(MDCV\)](#)]

[[Radial Deconvolution \(RDCV\)](#)] [[RDCV @model](#)] [[RDCV @sample](#)]

[[Cross-well Deconvolution \(XDCV\)](#)] [[XDCV @model](#)] [[XDCV @sample](#)]

[[Material Balance Analysis](#)] [[Capacitance Resistance Model \(CRM\)](#)] [[Pressure Transient Analysis \(PTA\)](#)]