2nd International Workshop on High-Order CFD Methods

Test Case C1.3: Steady Flow over the NACA0012 Airfoil

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Method Overview

	Method
UMich	DG, Damped Newton, GMRES, Line-Jacobi, Quads, Output-based hp-adaptation
RWTH	HDG, Damped Newton, GMRES, ILU, Triangles, Output-based h-adaptation
Twente	SBP-SAT, Newton, GMRES, ILU
LIU	SBP-SAT
MIT^{2012}	DG, Damped Newton, GMRES, ILU, Triangles Output-based, anisotropic h-adaptation
DLR^{2012}	DG, Damped Newton, GMRES, ILU, Quads
UW^{2012}	DG, Newton, GMRES, colored GS/hp-MG, Triangles/Quads, Output-based hp-adaptation

Convergence Summary

Test Case C1.3a (Subsonic inviscid)

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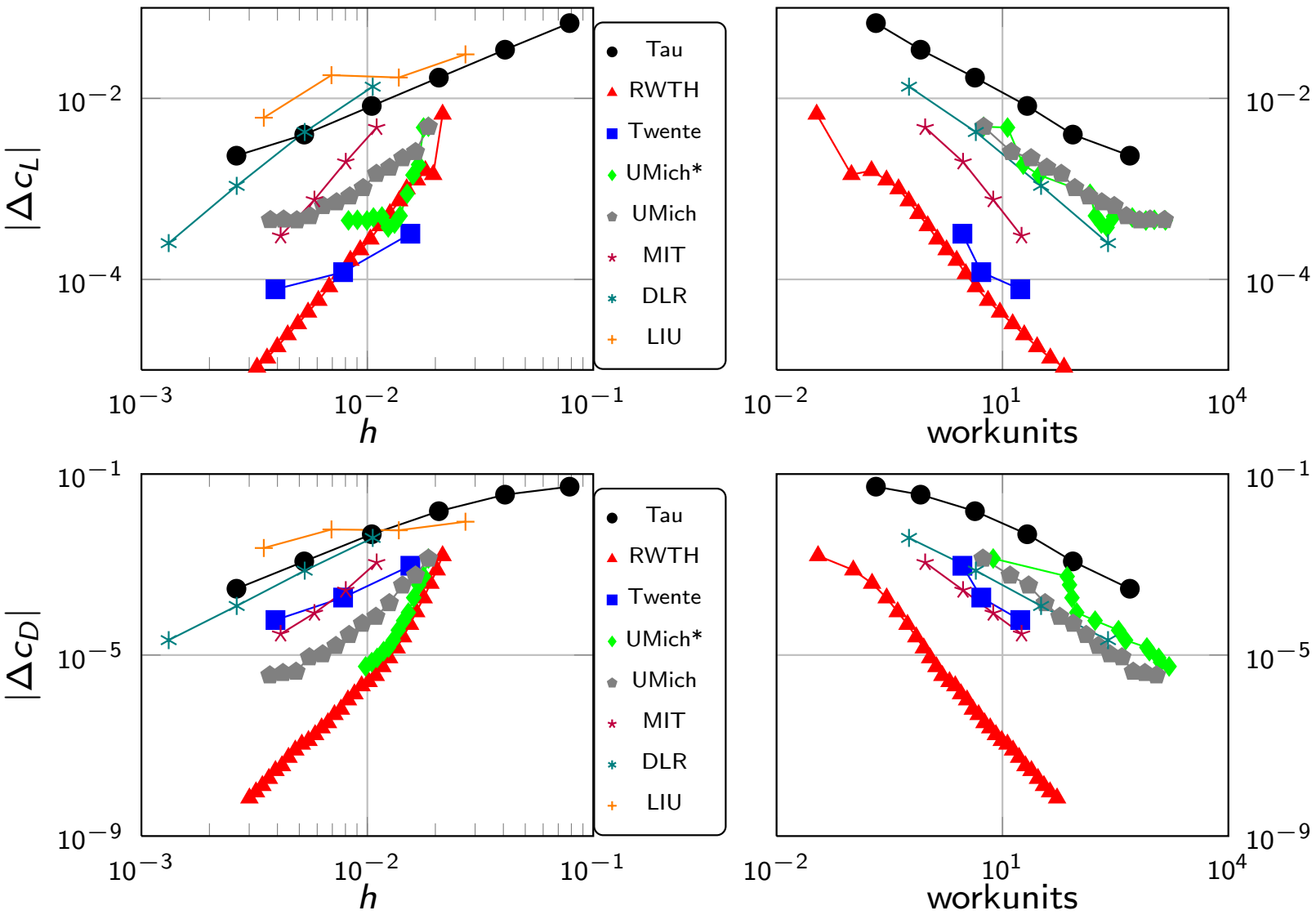
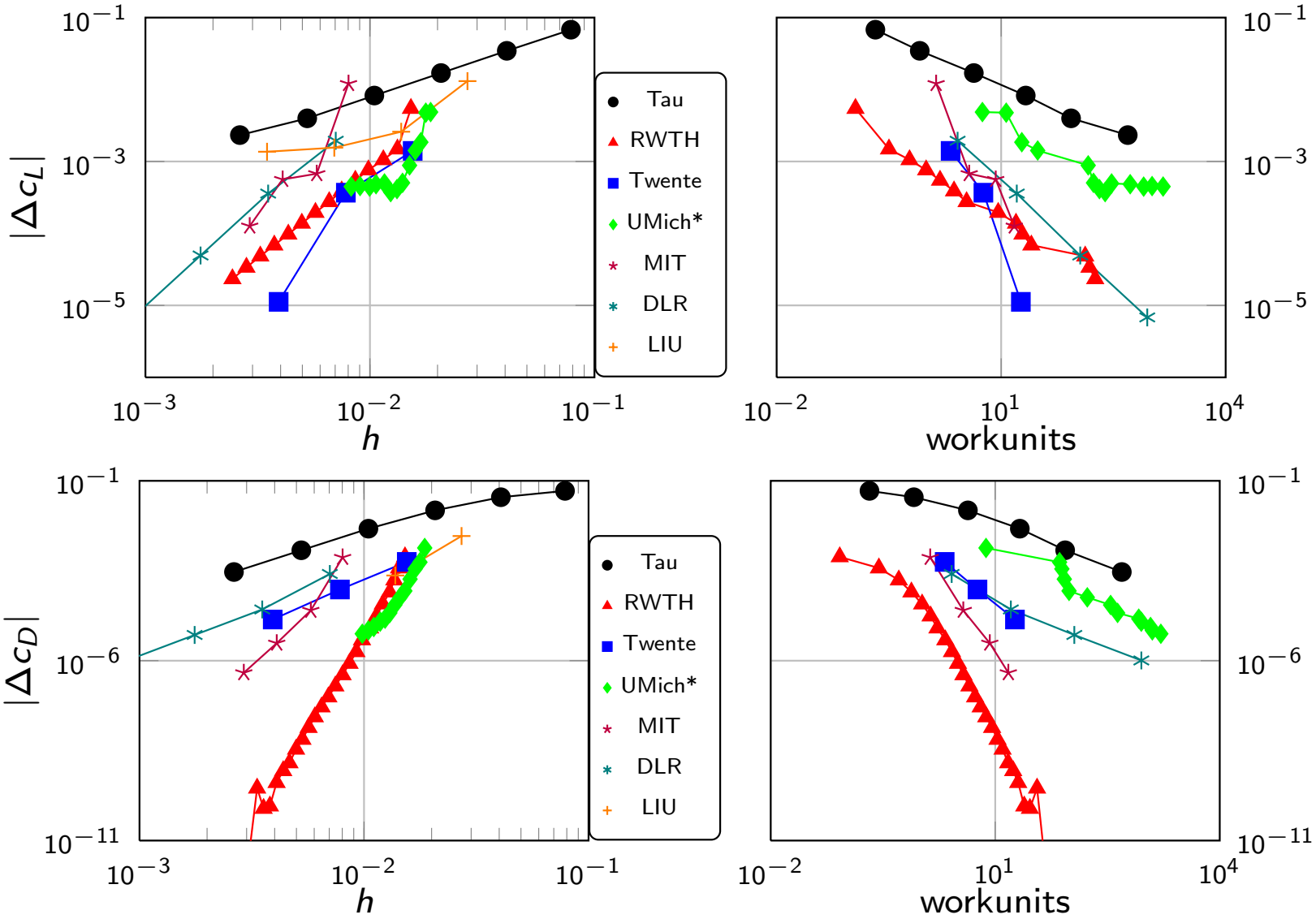
	$c_{L,ref}$	$c_{D,ref}$
Tau	$2.879600 \cdot 10^{-1}$	0
RWTH	$2.864086 \cdot 10^{-1}$	$4.664340 \cdot 10^{-6}$
UMich	$2.864792 \cdot 10^{-1}$	$2.140579 \cdot 10^{-6}$
MIT	$2.865273 \cdot 10^{-1}$	$3.510595 \cdot 10^{-7}$
DLR	$2.864831 \cdot 10^{-1}$	0
Twente	- (see UMich)	- (see UMich)
LIU	- (see UMich)	- (see UMich)

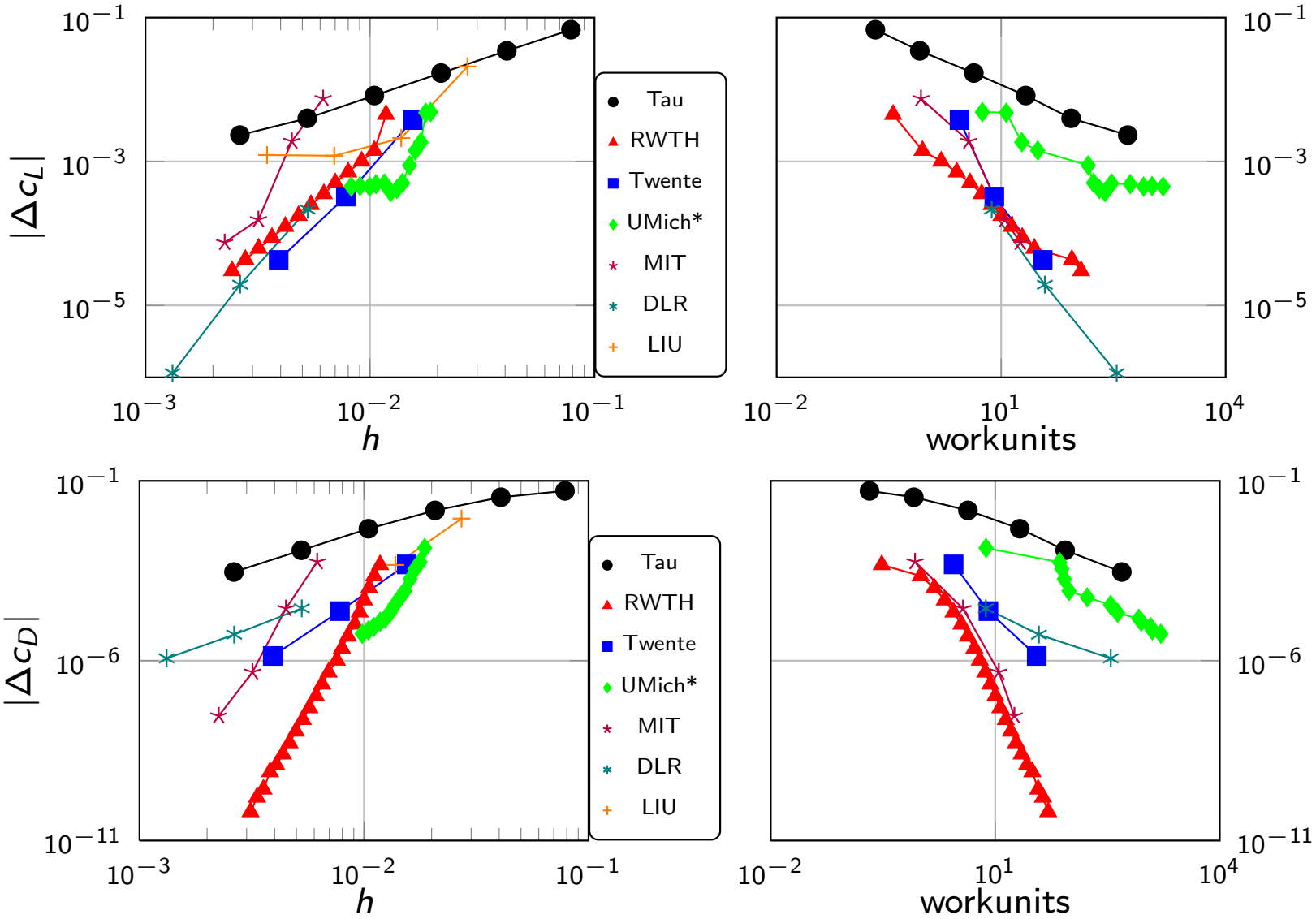
Test Case C1.3a (Subsonic Inviscid) — $p = 1$



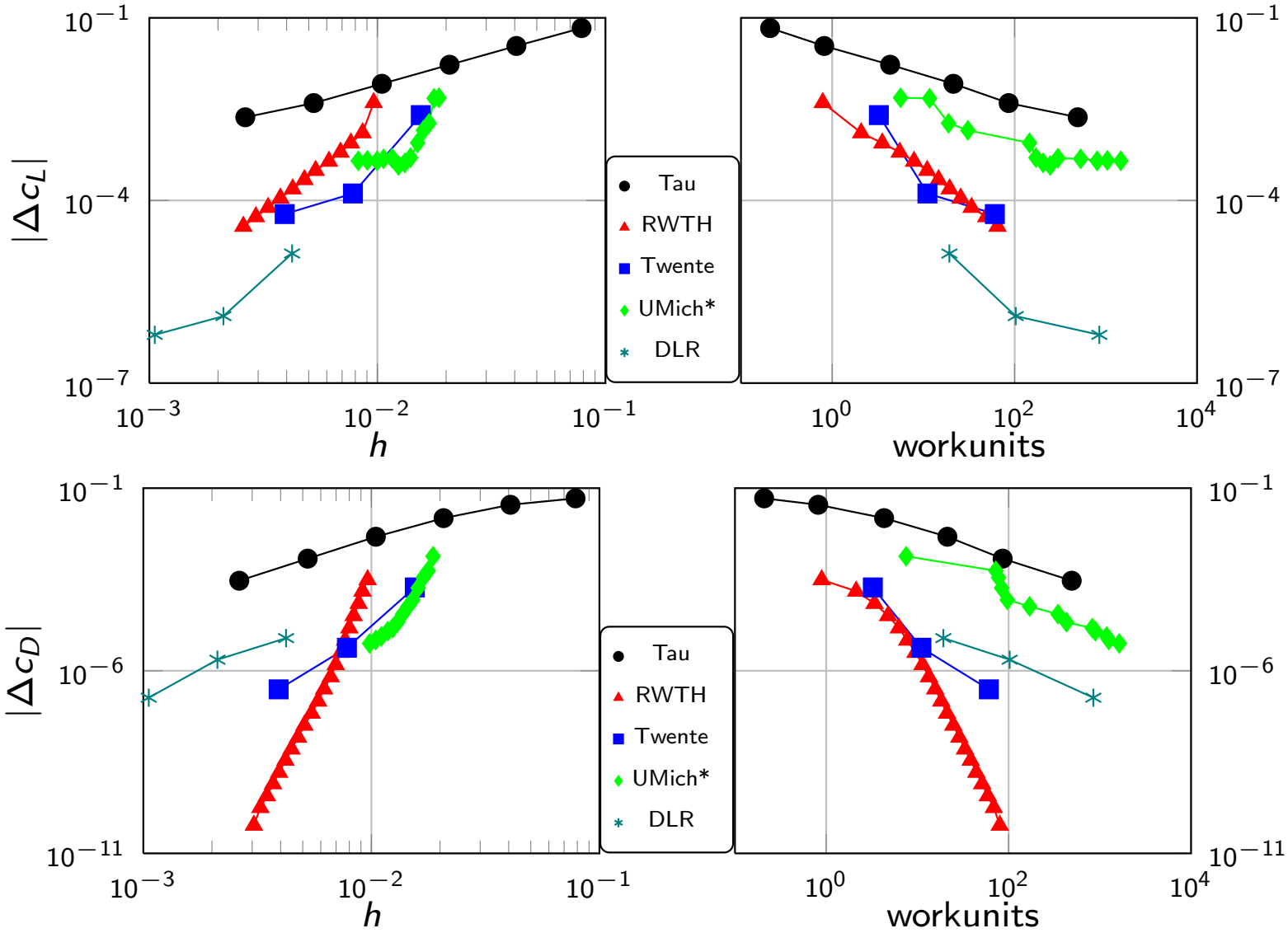
Test Case C1.3a (Subsonic Inviscid) — $p = 2$



Test Case C1.3a (Subsonic Inviscid) — $p = 3$



Test Case C1.3a (Subsonic Inviscid) — $p = 4$



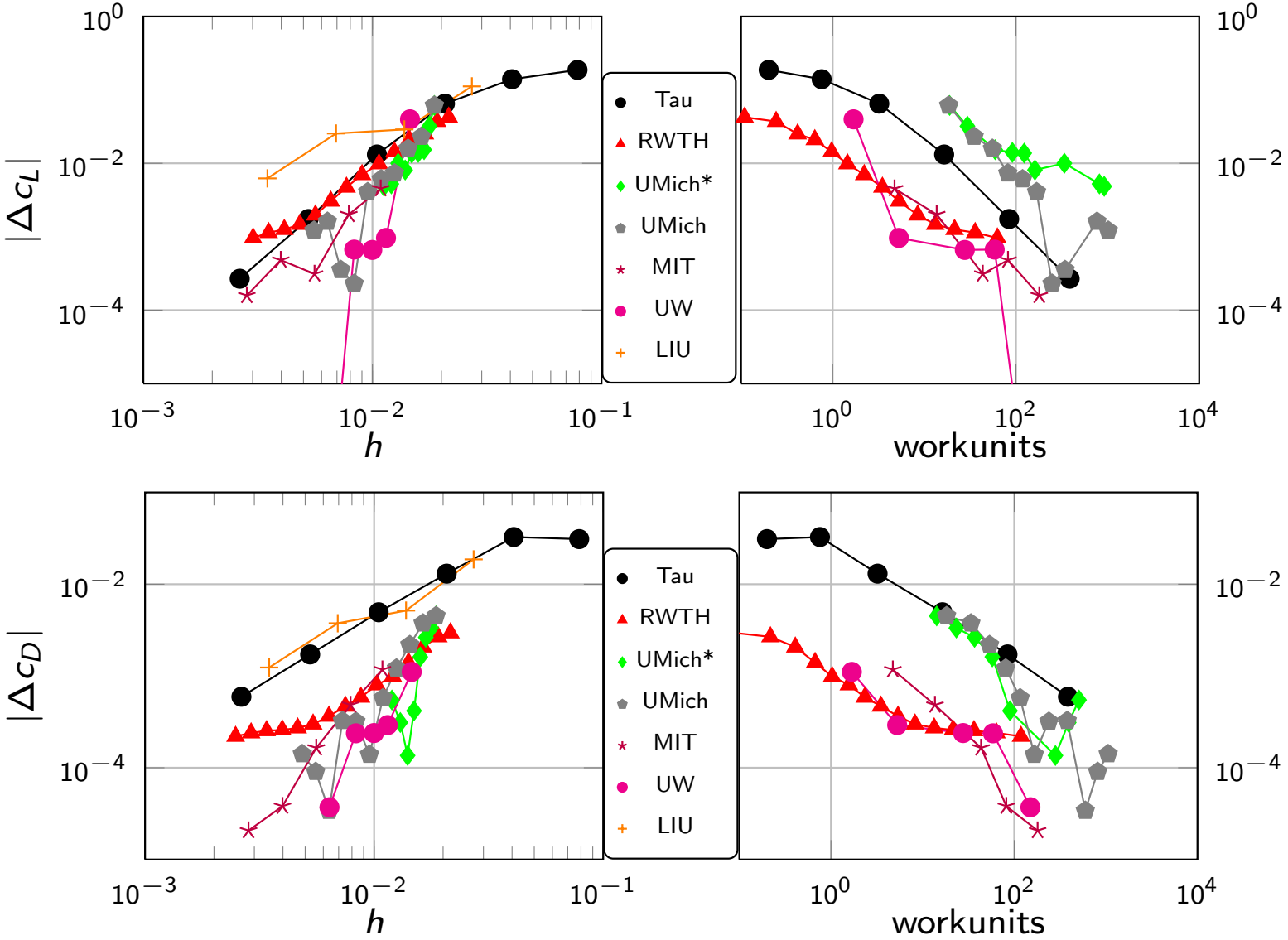
Convergence Summary

Test Case C1.3b (Transonic inviscid)

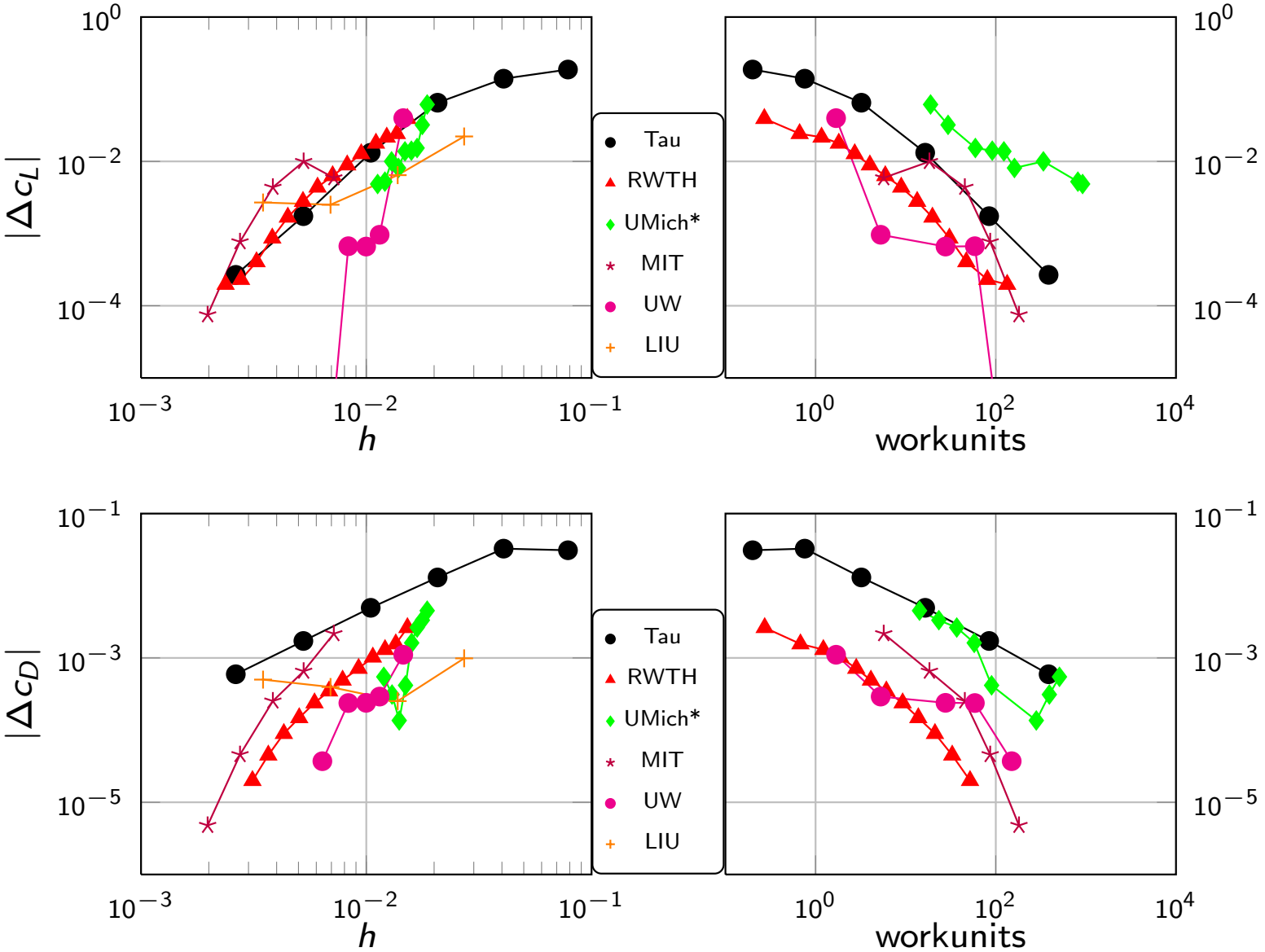
Test Case C1.3a (Transonic Inviscid)

	$c_{L,ref}$	$c_{D,ref}$
Tau	$3.645358 \cdot 10^{-1}$	$2.300700 \cdot 10^{-2}$
RWTH	$3.529140 \cdot 10^{-1}$	$2.274636 \cdot 10^{-2}$
UMich	$3.520217 \cdot 10^{-1}$	$2.262599 \cdot 10^{-2}$
MIT	$3.516940 \cdot 10^{-1}$	$2.262752 \cdot 10^{-2}$
LIU	- (see UMich)	- (see UMich)

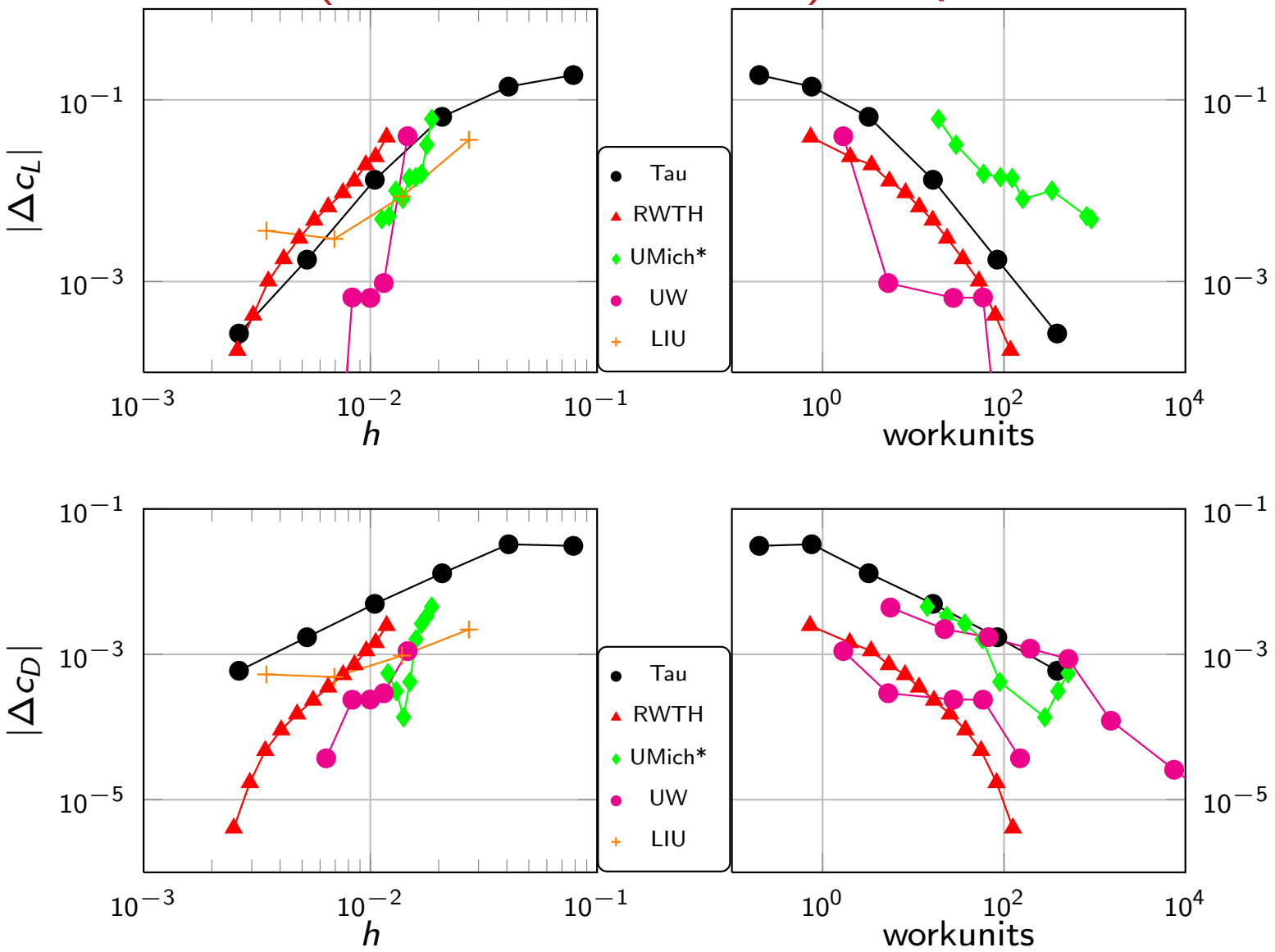
Test Case C1.3b (Transonic Inviscid) — $p = 1$



Test Case C1.3b (Transonic Inviscid) — $p = 2$



Test Case C1.3b (Transonic Inviscid) — $p = 3$



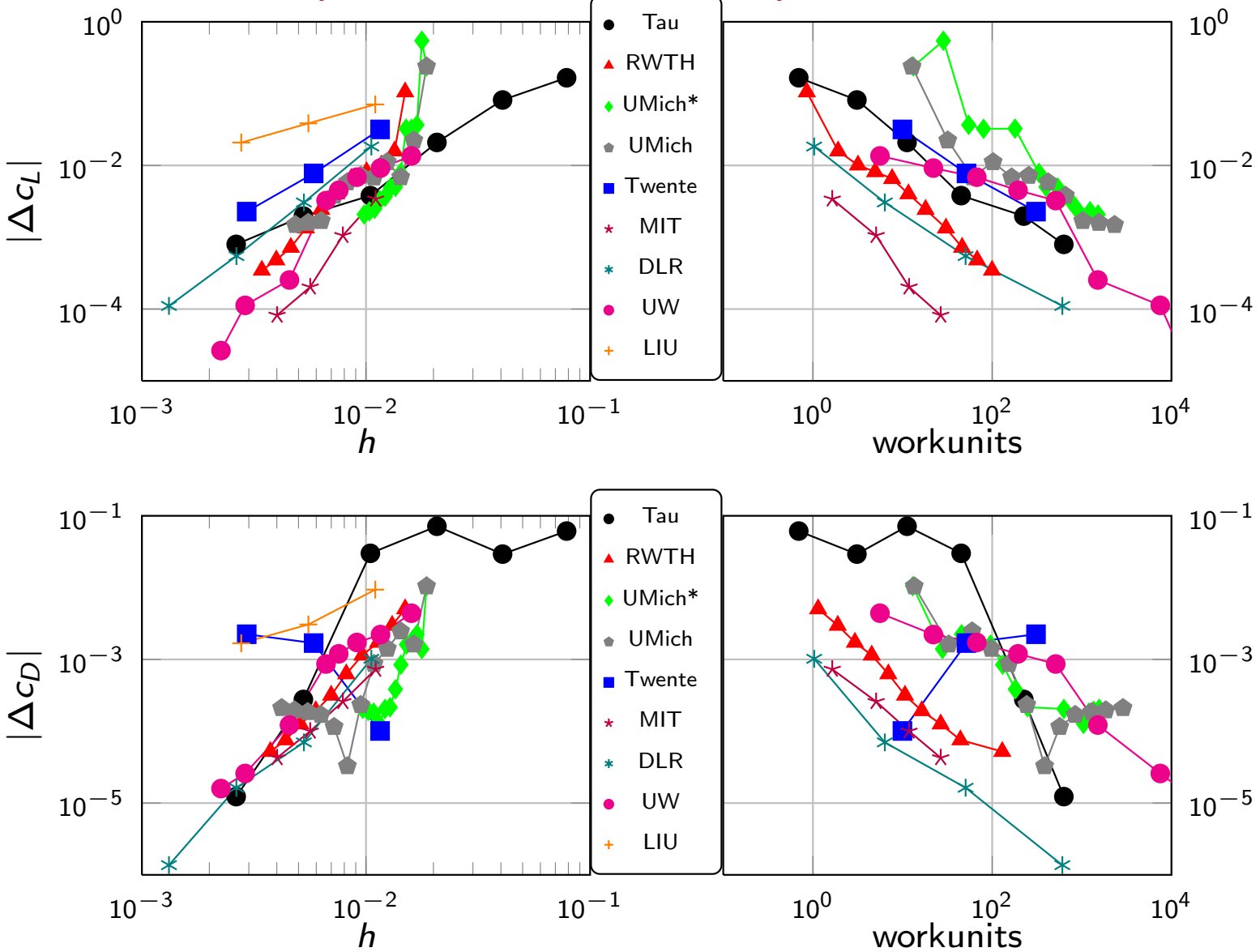
Convergence Summary

Test Case C1.3c (Subsonic viscous)

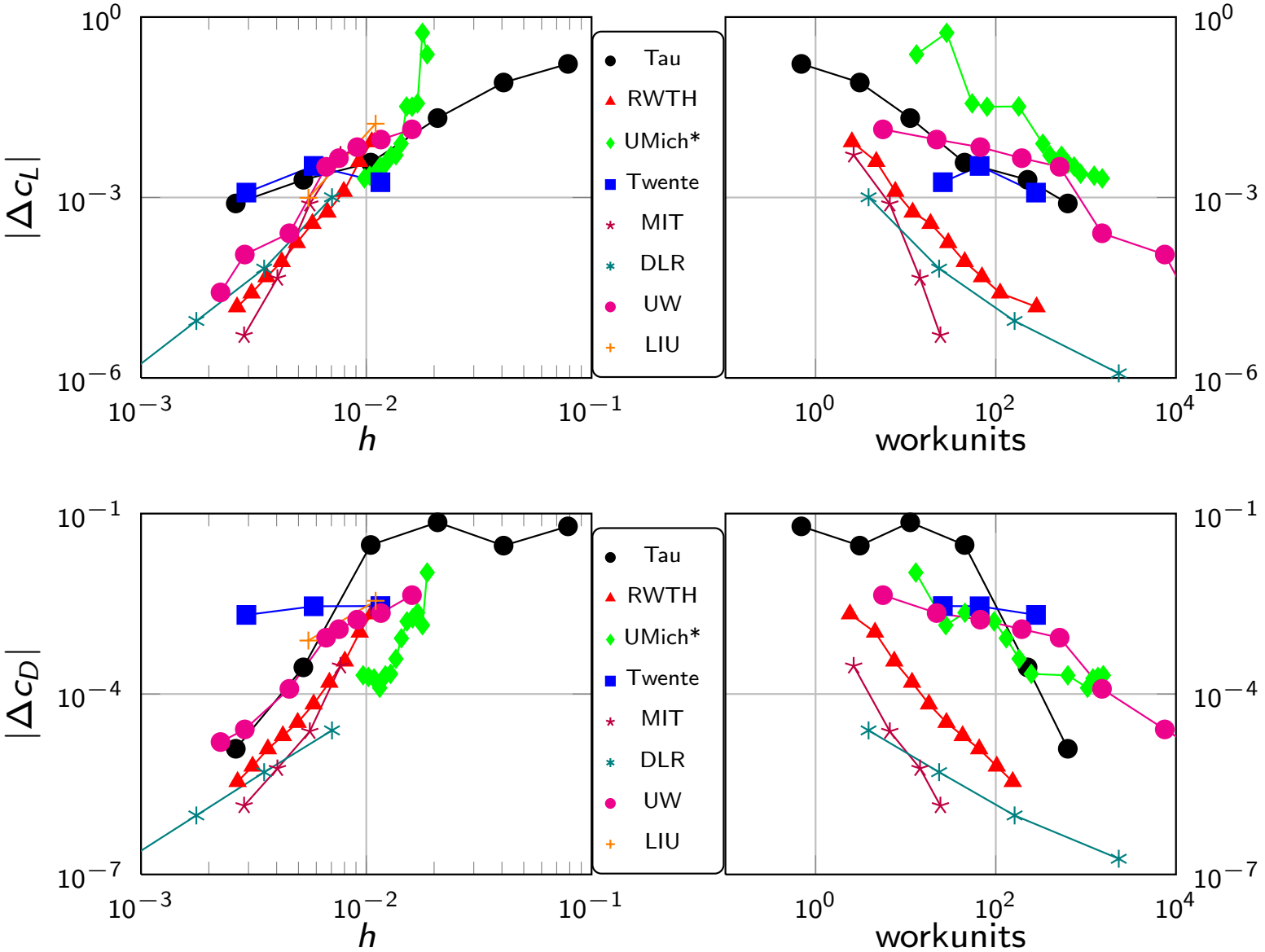
Test Case C1.3c (Subsonic Viscous)

	$c_{L,ref}$	$c_{D,ref}$
Tau	$2.275900 \cdot 10^{-2}$	$4.161700 \cdot 10^{-2}$
RWTH	$1.827391 \cdot 10^{-2}$	$5.531725 \cdot 10^{-2}$
UMich	$1.827362 \cdot 10^{-2}$	$5.531680 \cdot 10^{-2}$
MIT	$1.827381 \cdot 10^{-2}$	$5.531673 \cdot 10^{-2}$
DLR	$1.826595 \cdot 10^{-2}$	$5.531656 \cdot 10^{-2}$
Twente	- (see UMich)	- (see UMich)
LIU	- (see UMich)	- (see UMich)

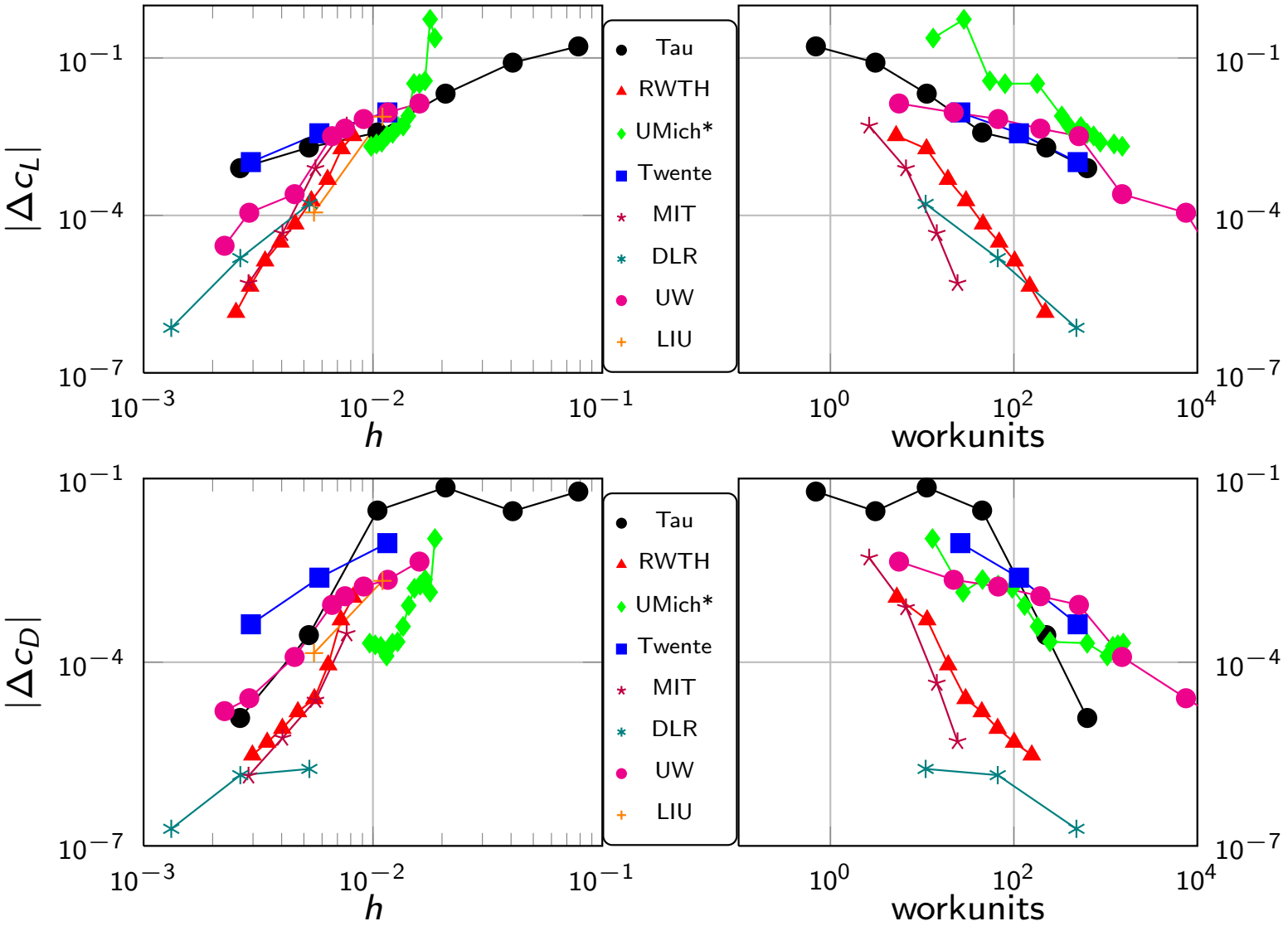
Test Case C1.3c (Subsonic Viscous) — $p = 1$



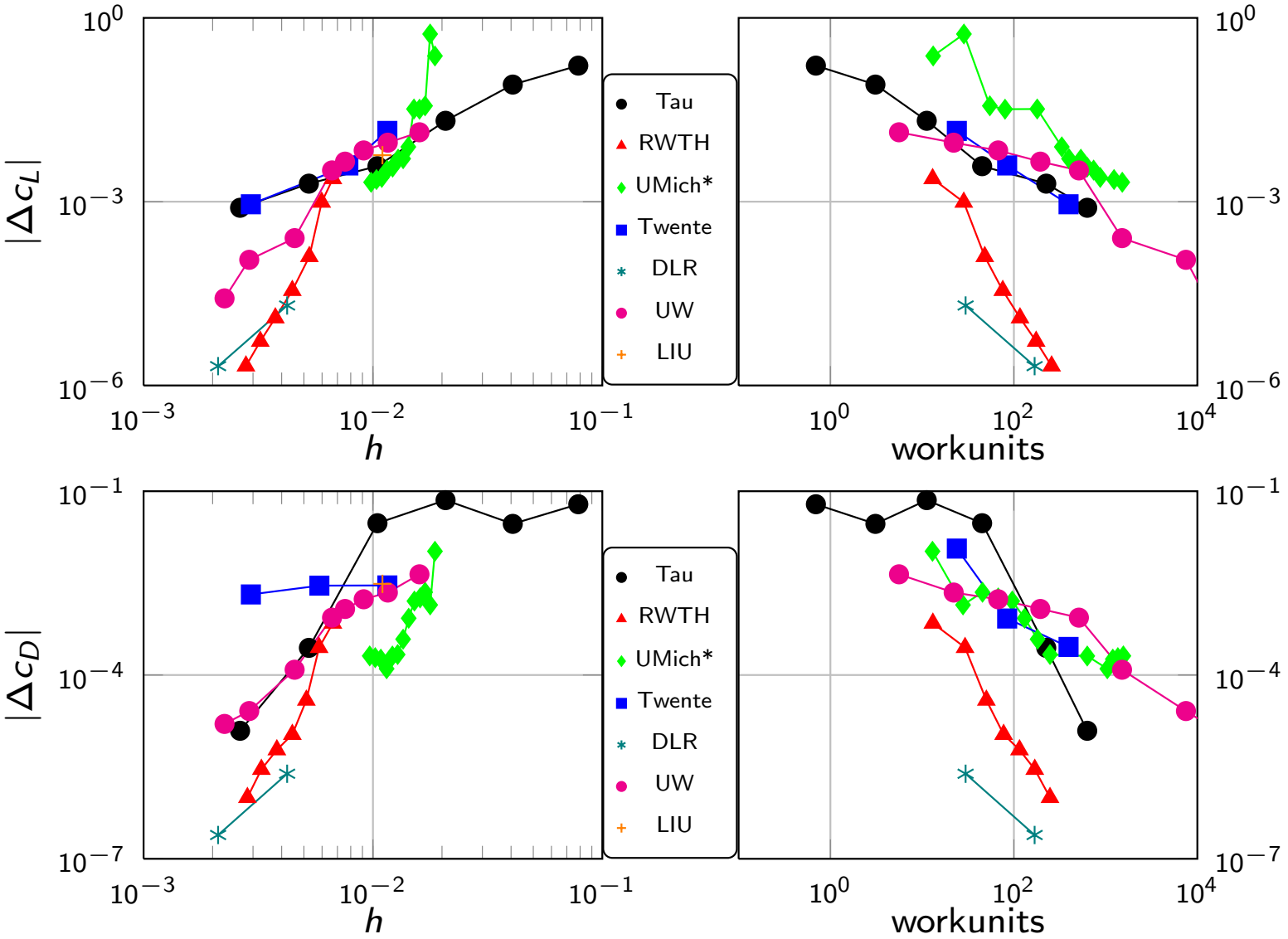
Test Case C1.3c (Subsonic Viscous) — $p = 2$



Test Case C1.3c (Subsonic Viscous) — $p = 3$



Test Case C1.3c (Subsonic Viscous) — $p = 4$



Conclusions

- Lack of reference values
- Convergence in lift and drag shows considerable scatter
- Adaptive mesh refinenement demonstrates advantages